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THE
CABINET
OF
USEFUL
ARTS AND MANUFACTURES :
DESIGNED
FOR THE PERUSAL
OF
YOUNG PERSONS.

LONDON :
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P R E F A C E.

THE following little Book is designed to give an insight into some of those Arts and Manufactures, which minister daily, nay hourly, to our convenience and comfort; though perhaps, many of us have never yet reflected how much, even the poorest are indebted to them.

Let the young reader also call to mind, that human ingenuity could never have produced these improvements, unless *the Almighty* had bounteously supplied the materials on which it was exercised. It is to Him we are indebted for the powers of the understanding.—It is He also, who produces the fleecy covering of the sheep, the silken residence of the

caterpillar, and the delicate plant of the flax. The perusal, therefore, of these pages, will it is hoped, raise our thoughts with reverence and gratitude to that great Creator, who hath so done his marvellous works, that they ought to be had in remembrance.



CABINET
OF
USEFUL
ARTS AND MANUFACTURES.

MANUFACTURE OF GLASS.

OF all the substances which contribute to the comfort of man, and are afforded by providence in an abundance proportioned to their usefulness, sand is perhaps that on which the greatest ingenuity has been exercised. It is not necessary to enlarge on its uses in agriculture; by which though barren itself, it renders their soils fruitful, when rightly mixed with them. Nor yet in forming, when mixed with lime, the mortar which binds and holds together the bricks and stones of which our houses and bridges are built, these are obvious to every person, who allows himself to reflect upon the objects which are every moment before his eyes. We shall therefore proceed to describe its use in the manufacture of glass, a material, of which the poorest amongst us enjoys the advantage. B

This remarkable change from a substance so gross and dirty as sand, into one so transparent and beautiful, is made by mixing sand with the ashes of burnt plants, and exposing them to a strong fire. When this mass has melted, the glass-blower can fashion it into any shape he pleases; he forms it into a bottle, or a bowl, a cup, or a hollow tube; he makes it round as a ball, or flat as a wafer; he cuts it with scissars like a piece of cloth, and by these operations produces those numerous domestic vessels which, by reason of their cleanliness, are for many purposes preferable to those made of the most precious metals.

Glass also affords for our windows, a thin transparent substance, which though sufficiently close to keep out the cold and rain, admits into our rooms the cheerful light of day, and at the same time enables us to see clearly the objects which are without. In former times, canvas, or linen cloth was used; and so dear was the price of this improvement when first introduced, that none but the most opulent were able to enjoy a luxury, which may be found to-day in the humblest cottage in Ireland.

The first discovery of glass was made by accident.—A merchant vessel was dri-

ven upon the coast of Asia by stress of weather and running ashore, the crew left her in order to look for provisions ; they afterwards lighted a fire on the strand, using as fuel an herb which when burnt produces soda. The ashes of this plant mixing with the sand, the heat converted them into glass. The natives immediately profited by the hint, and in a short time, the glass vessels made by them were sought for over all the civilized world.—We shall subjoin however, a circumstantial account of the mode of working in glass-houses.

When the sand and ashes have been mixed together in the proper proportions, and melted in a strong fire, the workman who blows the glass, takes his blowing-iron, which is a hollow tube, about two feet and a half long, and dipping it in the melting pot, turns it about: the metal or melted matter sticks to the iron like honey : he dips four times for the bowl part of every drinking-glass, and at every dip, rolls the end of his instrument, with the glass on it, on a piece of iron, under which is a vessel of water, which by its coolness consolidates the glass, and disposes it to bind better with the next to be taken out of the pot. When he has got enough of matter on the instrument, he

begins to blow gently through it, in the same manner as boys blow soap-suds through a pipe, and in order to give it a polish, he rolls it backwards and forwards on a stone or marble : after blowing, and whirling the iron till he has formed the glass to the intended shape, he delivers it to the master-workman to break off the collet, which is a little piece that sticks to the iron. In order to hollow it out, another workman thrusts in an iron instrument, and turns it round with a circular motion till it is sufficiently enlarged. —When it is perfectly formed, it is set in the lear, or third furnace to anneal or harden : it is proper to add, that the stem, and the foot of a drinking-glass, require each a distinct operation.

Habit and long practice enable those men to endure the most scorching heats, which they receive directly in their faces, mouths and lungs. They are always obliged to work in their shirts, with a broad brimmed straw hat on their heads, to preserve their eyes from the excessive heat and light. They sit in large wooden chairs with long elbows, to which their instruments are hung. They work for six hours without intermission, when they are relieved by another set of workmen, who take their places for the same space of time.

To form panes of glass for windows, the workman contrives to blow, and dispose his glass so as to form a cylinder, which by frequently heating and working on a kind of earthen table, at length begins to open and unfold like a sheet of paper, a previous notch or incision being made in it for that purpose, and thus it becomes flat; the table of glass is now nearly perfected; and requires nothing farther, but to be heated over again. When taken out, they lay it on a table of copper, from whence it is carried to the third furnace to harden.

There are two methods of making plates for looking-glasses; the one, by blowing them, much in the same manner as they blow glass for windows, but on a larger scale. The other, by casting or running them, which is generally practised in making large glasses. It is performed in nearly a similar manner to the casting of sheet-lead, and this method not only enables them to make glasses of more than double the size of any made by blowing, but also to cast all kinds of borders, mouldings, &c. The furnaces for melting the materials of this manufacture are of enormous size, and those for annealing or hardening the glasses when

formed, still larger. At the Castle of St. Gobin, in France, celebrated for its excellence in this manufacture, there are, at least, twenty-four annealing furnaces or ovens, each above twenty feet long, placed around a melting furnace. All these furnaces are covered over with a large shed, under which are likewise built forges, and work-houses for smiths, carpenters, and other artificers, who are continually employed in repairing and keeping in order the machines, furnaces, &c. as also apartments for these, and the workmen employed about the glass; so that the whole place appears more like a little city, than an assemblage of workmen's sheds. The insides of the furnaces are lined with a sort of baked earth, adapted to sustain the action of fire; and the same earth serves also for the melting-pots, cisterns, &c. The cisterns are about a yard long, and half as wide, they serve for the conveyance of liquid glass, which is drawn out of the melting-pots, to the casting tables. When the matter is sufficiently vitrified, refined, and settled, they fill the cisterns, and leave them in the furnace, till they appear white, through extreme heat. The table on which the glass is to be run, is of cast

iron. There is a curious machinery to remove the cisterns from the furnaces to the table, which places them in an inclined position, so as to discharge a torrent of matter, like liquid fire, with which the table is presently covered. As soon as the glass is come to a consistence, they shove it off into the annealing furnace, with an iron raker as wide as the table, being assisted by workmen on the other side of the furnace, who pull it to them with iron hooks.

The surprising dexterity and quickness, with which they perform the different operations, is inconceivable to those who have not been eye-witnesses of that wonderful manufacture. The tisors, or persons employed in heating the large furnaces, run round the furnace in their shirts, without the least intermission, with a speed scarcely inferior to that of the lightest courier; as they go along, they take two billets of wood, and throw them into the first furnace, and continuing their course, do the same for the second. This they hold uninterruptedly for six hours together. One would not expect, that two such small pieces of wood, which are consumed in an instant, would maintain the furnace in a proper

degree of heat, which is so great, that a large bar of iron, laid at one of the mouths of the furnace, becomes red hot in less than half a minute.

The process of these glasses is now completed, except grinding, polishing, and laying on of the quicksilver. The grinding of glass requires great nicety, when performed on glasses that are designed for telescopes, or other optical uses. Plate or cast glass is ground by placing it on a stone table, in such a manner, that it cannot be shaken or displaced, and then by means of a wooden frame, another glass is rubbed backwards and forwards over it, with water and sand between them, and thus by constant attrition their surfaces become smooth.

Various are the uses to which the ingenious invention of glass is applied; besides the different accommodations with which it supplies domestic wants, such as windows, looking-glasses, and all the innumerable variety of vessels that adorn our tables, and contribute to our convenience. Natural philosophy is greatly assisted by telescopes, microscopes, magnifying glasses, &c. which enable us to view objects too minute, or too distant ever to be examined by the naked eye.—

The eye-sight of aged persons, or those who have a defective sight, receives relief from spectacles, which they must have sought in vain, without this invention. They were the fortunate discovery of a monk of Pisa, in the year 1299. Nor does it only serve for useful purposes: it also supplies us with various kinds of ornaments. Most of the precious stones are so well imitated by this composition, as to deceive the eye of those, who are not critical judges.



THE

MANUFACTURE OF PORCELAIN.

THE globe which we inhabit may be compared to a vast store-house, in which Providence has laid up a variety of materials for the exercise of our industry and invention. Few things in their natural state are adapted to our use, though scarcely the meanest is void of utility, when combined with other substances, or wrought by the ingenuity of man. Vegetables, minerals, and animals, were formed with the benevolent design of supplying all our wants; but they demand a greater or less degree of ingenuity and manual labour, before they become fitted for their several purposes. No two substances, for example, appear at first sight so opposite in their nature as the plant from which flax is obtained, and the linen which affords us such a comfortable article of clothing. Yet we are certain that it once grew in a field, and required the labour of many hands to produce such a wonderful change. It

has also been already mentioned, that the clear transparent substance which we call glass, is formed from sand and ashes ; but no alteration which art produces is more strange than what has taken place in Porcelain, or China-ware ; for who could suppose that this, which is so smooth and glossy and delicate, was once a coarse misshapen hard rock ? it will, therefore, be interesting to follow up the history of this manufacture, and not without its instruction also, if we draw from it the lesson, that a life of sloth and inactivity are unsuited to our nature, since so many blessings on earth are the reward of labour.

The following is the mode of manufacturing porcelain in China, where it has arrived at the greatest perfection.

The first porcelain that was seen in Europe, was brought from China about one hundred years ago ; it was then called China-ware. The whiteness, transparency, neatness, and even magnificence of this pottery, did not fail to excite the industry of Europe, and their attempts to imitate it have succeeded completely. In England, France, and Saxony, earthen wares have been made so like the Eastern, that they are considered but

little inferior. It will be sufficient, however, to describe the process adopted by the Chinese.

There are two kinds of earth, or rather stones, used in the composition of this article. The first earth, called Kaolin, is intermixed with little shining particles. The other, called Petunse, is purely white, and very fine to the touch. They are both found in quarries, twenty or thirty leagues from Kingtiching, the name of the town where the most considerable china works are carried on, and which is said to contain nearly a million and a half of inhabitants. To this latter place, the stones are brought in a number of little barks, constantly passing up and down the river Iatcheou, for that purpose. The petunses are cut from the quarries in the form of bricks; being naturally pieces of a very hard rock, a large iron club is used for breaking these stones; they are afterwards put into mortars, and pounded till they are reduced to a very fine powder. The dust is then thrown into an urn full of water, and stirred briskly with an iron instrument. After letting it stand a while, the lighter parts of the powder form a thick cream on the surface, which the workmen care-

fully skim off into another vessel filled with water, leaving the heavier sediments at the bottom, to be pounded anew. In this second vessel the petunse is suffered to remain until it has formed a thick crust at the bottom, the water is then cleared off, and the paste thrown into large brick-shaped moulds, proper for drying it; it is afterwards mixed with kaolin, in proper proportion. The kaolin is a much softer substance when dug out of the quarry, yet this is the ingredient which gives strength and firmness to the work. The mines in which it is found in small lumps or clods are very deep. It goes through the same process and is formed into bricks like the petunse.

To these two substances must now be added, the oils or varnishes from which it derives its splendour and brightness, which is formed by mixing the creaming paste of the petunse with a mineral resembling alum; to the oil thus prepared is added another kind, extracted from lime and fern ashes.

The hardest part of the work is the kneading the two earths together, which is done in large cisterns or basins, till the mass is well mixed, and grows hard by the workmen trampling it continually

with their feet. When taken out of the basins, they are obliged to knead it again with their hands, after having divided it into smaller pieces. On this operation the perfection of the work depends, as the presence of the smallest foreign body would be sufficient to spoil the whole ; a grain of sand, or a single hair, would sometimes cause the porcelain to crack or splinter.

The different form of the vessels is effected by a turning wheel, as in the making of common pottery-ware ; moulds are used in forming the figures of men or other animals ; raised ornaments also, such as handles, flowers, &c. are cast first in moulds, and then attached to the vessel by a cement of porcelain earth moistened with water ; these last, however, are finished with the chisel, so that it is rather a work of sculpture than mere pottery.

The colours with which the Chinese paint their porcelain, far exceed ours in brilliancy ; in the design of the painting however, they are exceedingly deficient, as may be collected from the uncouth disproportioned figures seen on their finest ware. In this part of the process, the French certainly excel the rest of the world ; their painting being so highly and exquisitely finished, as often to give a

value of twenty guineas to a plate of the ordinary dinner size. All these paints are powders of certain metals, as copper, to give a green colour, iron to impart a brown or black, mixed with a kind of glass that easily melts, and ground with gum-water or oil to render them fit for use. A powder of gold, also, is used for gilding; and they are laid on with a fine painting brush of camel's hair; the painted, or gilded, porcelains are then exposed to a fire, capable of melting the glass with which the metallic colours are mixed; by this means they adhere, and acquire a gloss equal to that of the glazing of the china. The gold receives additional brightness from rubbing it with the burnishing stone.

The next operation is applying the oil or varnish, the mode of preparing which has been already described; according to the quality of the work, the varnish is laid on, more or less thick, and seldomer or oftener repeated; much art also is required in putting it on; all parts of the vessel should be equally covered, and no spot thicker than the rest, which would destroy the smoothness and polish of the surface.

Two kinds of furnaces or ovens are used in baking China-ware, which is the last

process; large ones for works that are baked only once, and smaller ones for those that require a double baking. The ovens are composed of a mixture of three different sorts of earth. At the top of the dome, which is in the form of a tunnel, is a large aperture, to give vent to the flames and smoke, mounting up continually, as soon as the oven is once lighted. The pieces of porcelain that are baked in the large ovens, are put into cases or coffins, as they are called, made of the same materials as the ovens, to prevent any diminution of lustre, from the too violent effect of a naked fire. Great caution is necessary in placing the pieces of porcelain in the smaller ovens, no cases being used; they are piled up in pyramids, so that no part of that which is painted in one, touches the paint in another, lest the colours should run, and destroy the beauty of the whole.

The work-houses are properly vast-yards, walled round, with sheds and convenience for the defence of the workmen against the weather, as well as other buildings adapted to provide them with dwellings. This manufacture, like several others, employs a prodigious number of hands. Almost every piece is

handled by twenty workmen, before it is ready for the painter, and by more than sixty, before it attains perfection. The painting work is distributed amongst a great number of artists in the same laboratory. One paints nothing but borders, another traces out flowers, and gives them to one of his fellow-labourers to lay on the shades; waters and mountains alone employ a fourth hand, birds and other animals a fifth, whilst the human figure is reserved for the work of a particular person. There are porcelains made of all colours, both with respect to the grounds, and the representations upon them. Some are simple, consisting of one colour, as blue; others composed of a variety of tints; and others are heightened with gold. This multiplicity of workmen is found, by experience, to forward rather than retard the work, not only in this, but in all manufactures where various operations are necessary. Each workman, by continual application to the same object, acquires dexterity and facility in that branch of the art, and not only performs his part more expeditiously, but better, by frequent repetition.

We shall perceive this more plainly by

considering the manner in which a common tea-cup is made. The stone is quarried in Cornwall, in the south of England, and sent to the potteries in Staffordshire, after it has been pounded and refined by washing in the way above described. The potter who has the management of the wheel, takes this paste and gives the cup its form, height, and diameter. A second workman fits it to its bottom; a third receives it from him, and applies it to a mould, to bring it to its form. A fourth polishes the cup with a chisel, especially about the edges, and reduces it to the proper thinness. Another workman turns it upon a mould to smooth its inside; the handles, or raised work ornaments, are added by different hands; and lastly, the foot is rounded and hollowed on the inside with a chisel, by a workman whose peculiar office it is. When arrived at this degree of maturity, it has still many operations to undergo, which require the skill of various artists. It must yet be painted, varnished, baked, and glazed. How much more tedious would the operation be if the same workmen were obliged to carry it through every process. What a waste of time in shifting his place at

every stage of the work, and in getting together and fitting to his hand so many different kinds of tools, besides that he never could be expected to arrive at excellence when his attention was occupied by so many different branches.

The mode of making those pictures which we see upon the sides of delft vessels, is exceedingly ingenious ; if the colours were laid on with the brush, it is evident that the expense would many times exceed the value of the article, but the process is at once so simple and expeditious, as not to add a farthing to the price, which would otherwise be charged for it.—After the vessel has been formed by the potter, and whilst the clay is still soft, an impression upon paper of the picture intended, is damped and laid on the proper place. The whole is afterwards put into the furnace to bake, by which the heat transfers the colours from the paper to the vessel.



THE LINEN MANUFACTURE.

THERE are many animals which know as well as man, to find out a dwelling for themselves: But no creature, except man, makes itself clothes. Universal experience shews us, that all civilized nations, in all ages, and in every part of the world, have looked upon the custom of covering the body, as an indispensable piece of decency, even though the exceeding calmness and serenity of the air, might not oblige them to use any precaution against it.

In the warmer parts of the earth, as in Africa, the black colour of the natives, and the natural oiliness of their skins, increased by the use of ointments and paint, sufficiently protect them against the ordinary inclemencies of the weather. Yet, even in those countries, the practice of going entirely naked is a sign of a state little advanced beyond the savage: and some kind of apparel is usually worn, at least by the superior classes. In all the cold and temperate parts of the globe, the want of clothing begins at the instant of birth, and is one of the most urgent.

The qualities of suppleness and consistence, which render different productions of nature fit for man's clothing, are not, properly speaking, his work. These qualities exist originally in the substances themselves, which he makes use of: and arise from the solidity, together with the lightness and elasticity of hair, down, the furs of all sorts of animals, the threads wherewith certain caterpillars encompass themselves, the fibres separated from certain barks, or the tufts taken out of the pods of some kinds of trees. Man has discovered and chosen what may be fit for his clothing, but the real excellence of these substances existed before he began to work upon them. He, who has bestowed them on us, has displayed at once his wisdom and benevolence, in placing within our reach the materials which so effectually answer the wants of man in this particular; but he has invited us to exercise our industry upon them, by rewarding it with success.

The first covering to the body in warm climates, may probably have been the large leaves of trees, fastened together by the fibres of the same; but this must have been so slight and little durable, as

soon to be set aside for better contrivances. To interweave the long and narrow leaves of plants of the grass or reed tribe, in the form of a mat, would be a pretty obvious expedient ; and to this day we find that some savage tribes have proceeded no farther. Yet, simple as this contrivance may seem, it is the origin of the art of weaving. A kind of clothing still more simple, probably occurred to the inhabitants of colder countries, namely, the skins of slain animals ; those very coverings bestowed by nature upon them, and denied to man. The savage hunter, who had killed a bear, at the same time made a display of his courage, and enjoyed the reward of it, by wrapping round him the shaggy spoils of his game. At this day, a sheep's skin, with the fleece outwards in summer, and inwards in winter, forms the principal garment of some northern people ; and we read of a very simple and compendious mode of clothing a young Tartar, by throwing over his shoulders the raw hide of a horse, and shaping it to his body with a pair of sheers. Clothing, as well as food, may therefore be divided into the vegetable and animal ; and we shall follow this order, in speaking of the manufactures which prepare them for our use.

The vegetable matters employed for this purpose, are chiefly of two kinds; the fibres of the stalks and other parts of plants, and the downy substance in which the seeds are sometimes bedded. The fibrous or stringy texture is very common in vegetables. We see it in the bark and wood of trees, in the stalks of green or grassy plants, and in the leaves of all. The longer parallel fibres are held together by shorter cross ones, forming a network, cemented by a glutinous matter. The ingenious, though but half-civilized people of Otaheite, have discovered a method of making tolerable cloth of the inner bark of certain trees, steeped in water, then beaten with a wooden mallet, and reduced to a soft pliable texture, much resembling in appearance woven cloth, though the fibres are never entirely separated. But this manufacture has the defect of not bearing to be washed, and is besides of little durability. The more artificial way of employing vegetable fibres, consists in an entire separation of them from the matter that held them together, reducing them to clean loose bundles, then twisting them into threads, and lastly interweaving them.

Before we mention the names of the

plants selected in our part of the world for the purpose of making thread and cloth from these fibres, let the reader endeavour to guess those we mean by the following general description.

Europe produces a little plant, whose fruit is an excellent nourishment to several birds; affords a kind of food good to fatten large cattle, and produces an oil that lights many families in the night; instead of the men, European women generally work off the bark of this plant, and manufacture it into those spreading sails, by the aid of which our ships transport their merchandize to the remotest parts of the world, and convey to us what ever we want; the same bark is worked into cables strong enough to bear the weight and force of anchors; and ropes, pack-thread, and girths are likewise made from its materials; it is of constant and universal use in navigation, commerce, husbandry, and domestic affairs; with the very bark, houses are made to shelter our soldiers; it likewise affords us the finest ornaments for our tables; we also form it into a dress which accommodates us day and night: is perfectly neat and convenient, and contributes as much to the health of

our bodies as the bath itself, to which it now succeeds, and from the trouble and preparation of which it entirely discharges us: In a word, this bark, according to the different forms given to it by Europeans, becomes the most ornamental habits of kings, and furnishes the husbandman and shepherd with a decent attire at a very inconsiderable expence. These are the benefits we receive from flax and hemp.

Flax is an annual plant, rising on a single stalk to a moderate height, and crowned with handsome blue flowers, succeeded by globular seed vessels.

Hemp is a much taller and stronger plant than flax. It has a square rough stalk, rising to the height of five or six feet, and sending off branches. It is an annual plant, produced from seed.

They may both be ranked in the same class; and though flax be much shorter and abundantly finer, it is a plant pretty much of the same nature, and employed in more beautiful manufactures. When the hemp and flax have been gathered, which is done by plucking them from the earth, the stalks are exposed to the sun, in order to ripen the seeds, which are afterwards threshed out of the heads, and

then the stalks are tied up in bundles, and steeped in a standing water, (the clearest is always the best,) being fastened to poles, and left to soak about fifteen days. When the substance of the stalks is almost rotten, the bundles are taken out and well dried. When the flax and hemp are well penetrated, and afterwards completely dried, they are beaten by handfuls, on a block with a kind of mallet; all the *bullen*, which is the inward substance of the stem, flies off in shivers by the force of the blows, and nothing remains in the hand of the beater but the thin bark, disengaged in large threads through the whole length of the stem. This parcel of threads is afterwards hung on a perpendicular board, and bruised with a wooden beetle, in order to shake out all the little straws that may happen to remain of the *bullen*. All the gross parts are now separated from the stem, and the threads of the bark remain in the hand of the manufacturer; these are afterwards entirely cleansed by the comb; or, in other words, they are drawn first through large cards, or iron teeth, and subsequently through others that are finer, that they may be purified from whatever may be still too thick and gross. This

refuse is what they call tow, of which a thick yarn is made for packing-cloths, which are of great use, since they wrap up and preserve the most valuable commodities in their transportation from one country to another.

The staple of flax is longer or shorter, coarser or finer, according to the soil in which it is grown, and the methods used in dressing it. The operation of spinning, which it next undergoes, consists in drawing out with the fingers several of the fibres together, and twisting them. This was originally done by means of a distaff, or rock, on which the flax was fastened, and which was stuck in the girdle, while one hand of the spinner was occupied in drawing out and twisting the thread, and the other in winding it upon a reel or spindle. But this method has long given way to the use of the machine called a spinning wheel, in which the twisting and winding are performed by means of a wheel turned by a treadle. Spinning has been a part of the domestic occupation of women from the earliest ages; and, notwithstanding the modern use of compound machinery, the spinning of flax is usually performed by them at home in the old way; although in large manufactories the

process is performed by machinery. The spinning wheel is a pleasing object in cottage-scenery; and it is desirable that some employments should be reserved in a simple state, which may fill up the vacant hours of rural life, and offer some reward to humble industry. The product of flax-spinning is linen-yarn, which is more or less fine according to the dexterity of the spinner, and the nature of the material. The greater part of this is made up in bundles, and sold to the weaver. Some, however, is doubled and twisted into thread, which is used for needle-work.

Weaving may be regarded as a finer kind of matting. To perform it, the threads, which form the length of a piece of cloth, are first disposed in order, and strained by weights to a proper tightness; and this is called the warp. These threads are divided by an instrument called a reed, into two sets, each composed of every other thread; and while, by the working of a treadle, each set is thrown alternately up and down, the cross threads, called the woof or weft, are dexterously cast between them, by means of a little instrument, sharp at both ends, called a shuttle. which is briskly shot from one of



THE WEAVER.

the weaver's hands to the other, placed on the opposite sides of the work, and carries the thread with it. This is the simplest kind of weaving; but numberless are the additional contrivances made for all the curious works wrought in the loom, which have been the objects of human ingenuity for many ages.

The linen fabrics are of all degrees of fineness, from coarse sheeting, to cambric, almost emulating a spider's web. They are brought to that extreme whiteness, which we so much admire, by the process of bleaching. This consists in their exposure to the action of the sun and air, after being boiled or steeped in a lie made of pot-ash and water, with frequent watering, and often with the help of some acid liquor, which quickens the operation, but is apt to injure the cloth, if not applied with great caution.

The value that can be given to a raw material by manufacturing is in few instances more strikingly exemplified than in the conversion of flax into point, or Brussels lace, some of which sells for several guineas a yard. Indeed, if you look at a plant of flax growing, and then at the lace of a lady's cap, you cannot fail to be struck with admiration of human skill

and industry. To illustrate, however, by an example, the increase in value which art can give to the raw materials, flax, at the best hand, is bought at two shillings per pound. Lace is made in the Low Countries, which sells for ten guineas a yard.—Now this yard of lace will probably not weigh more than half an ounce, and therefore is manufactured from a penny worth of flax ; that is, the yard of lace has acquired by hand labour a value 2730 times greater than the material it is made from.

Linen is one of the comforts of civilized life. It is cooler and more cleanly than any other wearing material, as it is free from downiness, and presents a smooth surface.—We therefore prefer linen for our under garments ; but it would be too cold for our climate did we not cover it with others of a warmer texture.



ROPE MAKING.

HEMP, as we have mentioned, undergoes the same general preparation as flax, before it is consigned to the weaver ; but, being of a stronger and coarser texture, it requires more labour to get the fine fibres separate from the rest. Hence it is commonly employed in the more homely manufactures, and hempen cloth is seldom made finer than to serve for sheeting and shirts for the lower classes. It is the principal material of sail-cloth, a fabric the strength of which is required to be proportional to the violence it has to undergo from storms and tempests. Hemp is rendered still more important to navigation from its use in making cordage. The consumption of hemp in a maritime nation like this, is prodigious, on which account, vast stores of it are constantly laid up in our naval arsenals. We shall therefore describe the manufacture, by which it is rendered of such important utility.

Rope-making is an art of such great importance, that hardly any business can be carried on without its assistance. Cordage makes the very sinews and mus-



THE ROPEMAKER.

cles of a ship; it furnishes nets to the fisherman, and enables him to supply our markets with abundance of cheap and nutritive food. It helps the mason to raise the largest blocks of stone, and to place them in the very spot where he makes use of them. In our manufactories some machines could not work without ropes; and there is scarcely any of the smaller trades, but are benefited in some way or other by their use.

The business of the rope-maker is to unite the strength of a great number of fibres by twisting them together; for this purpose it is not sufficient to lay the fibres parallel, and fasten the bundle at the two ends—from their shortness this would be of very limited use; they must be entangled therefore together, so that disposed in a long skein, these ends may succeed each other along its length, without many of them meeting in one place. Nor must the skein be twisted too hard, for in that case each fibre being already strained as much as if it was loaded with all the weight it could bear, any additional stress would cause them to break—hence the process of making ropes is more difficult than we should at first suppose.

The first part of the process is spinning

of rope-yarns, that is, twisting the hemp in the first instance for this purpose, in manufacturing such as is used in the standing and running rigging of ships. An alley or walk is inclosed for the purpose, about 200 fathoms (1200 yards) long, and of a breadth suited to the extent of the manufacture. It is sometimes covered above. At the upper end of this rope-walk is set up the spinning wheel: the band of this wheel goes over several rollers called whirls, turning on pivots in brass holes. The pivots at one end come through the frame, and terminate in little hooks. The wheel being turned by a winch, gives motion in one direction to all those whirls. The spinner has a bundle of dressed hemp round his waist, with the two ends meeting before him. The hemp is laid in this bundle in the same way that women spread the flax on the distaff. The spinner draws out a proper number of fibres, twists them with his fingers, and having got a sufficient length detached, he fixes it to the hooks of a whirl. The wheel is now turned, and the skein is twisted, becoming what is called a rope-yarn, and the spinner walks backwards down the rope-walk. The part already twisted draws along with it more fibres out of the bundle.

We may suppose him arrived at the lower end of the walk, or as far as is necessary for the intended length of his yarn. He calls out, and another immediately detaches the yarn from the hook of the whirl, and carries it aside to the reel: the second spinner then attaches his own hemp to the whirl-hook. In the mean time, the first spinner keeps fast hold of the end of his yarn; for the hemp being dry is very elastic, and if he were to let it go out of his hand, it would instantly untwist, and become little better than loose hemp. He waits, therefore, until he sees the reeler begin to turn the reel, and he goes slowly up the walk, keeping the yarn of an equal tightness all the way, till he arrives at the wheel, where he waits with his yarn in his hand until another spinner has finished his yarn. The first spinner takes it off the whirl-hook, joins it to his own, that it may follow it on the reel, and begins a new yarn.

The next thing to be done, is to convert these yarns into what may be properly called a rope, cord, or line, which is done by laying them together; the workman fastens the ends of two or three yarns to separate whirl-hooks, causing

the remote ends to meet in a knot. The winch then turns the whirl-hooks, and the yarns twine gradually together from the knot at the extremity of the walk. These yarns thus united make a *strand*, and a different number of strands form the ropes and cables of various sizes.—The whole is then tarred to render it less penetrable by water which would rot it in a short time, though when it is not exposed to alternate damp and dryness, white or untarred cordage is found to be considerably stronger.—The largest cable of a first-rate man-of-war is of an amazing size and strength, it measures twenty inches round, and will support a weight of 7772 lbs.—It is 720 feet long, which in seaman's phrase expresses a cable's length.

The following rule for judging of the weight which a rope will bear, is not far from the truth. It supposes them rather too strong; but it is so easily remembered that it may be of use.

Multiply the circumference in inches by itself, and take the 5th part of the product, it will express the tons which the rope will carry. Thus if the rope has six inches in circumference, six times

six is thirty-six, the fifth of which is $7\frac{1}{5}$ tons.

But we have not yet described all the advantages derived from flax and hemp. The seed of the former (which is sometimes called linseed,) as well as hempseed, is bruised with vast hammers which are too heavy for men to lift, and are set a-going with wheels which are turned by the stream of a river, by a steam engine, or some other power. The oil extracted thus has most of the qualities of the nut oil, and is used as a substitute for it in painting. The oil drawn without the assistance of fire, is much esteemed in medicine. After the oil is squeezed from the seed, the seeds are heated over the fire, and being put into woollen bags, are pressed into pieces about twelve inches long, and six inches wide, called oil cakes, and used to fatten cattle. These cakes beaten again to dust, become an excellent manure for land. Thus ingenuity and industry have applied almost every part of these plants to a valuable purpose.



THE COTTON MANUFACTURE.

THE inhabitant of the northern and temperate regions, has been obliged to exercise much labour and contrivance in procuring his vegetable clothing from the stalks of plants. In the mean time, the native of the fruitful south, has been enjoying the benefit of a material presented in greater abundance, and in a state requiring much less preparation before it is fitted for the manufacturer. This is *cotton*, a white woolly substance, contained in the seed pod of a species of plants, some of which are annual and grassy, others perennial and shrubby. The cotton-tree, or plant is probably a native of the warm regions of Asia, in which it has from time immemorial served to clothe multitudes of people. In the southern parts of Persia, the shrubby kinds grow wild. But the cultivated cotton, both in the East and West Indies, in Lesser Asia, and in some of the warmer climates of Europe, is generally the grassy sort, produced from seed. Its culture is easy, and any soil suits it when

once it has taken good root. In the West Indies, two crops of cotton are gathered in a year. The pods, when ripe, open of themselves, and the cotton is plucked out of them by the fingers, with the seeds sticking to it. The cotton is separated from the seeds by means of mills, which pull out and loosen the down. It is then in a state fit to be sent from the planter to the manufacturer.—The farther operations it undergoes are picking clean, carding, and roving, which last brings off the fibres longitudinally in a continued loose line. These are next twisted and drawn out, so as to make thread, or yarn; and the material is then consigned to the weaver. The vast extension of the cotton manufacture in this country, has caused these preparatory operations to be performed by a system of complex machinery, the invention of which has exercised all the ingenuity of the ablest mechanics.

The cotton-wool is first picked by women from the pods and seeds; it is then carded by cylindrical cards, which move against each other at different rates of quickness. It is taken from these by an iron-hand, or comb, which has a motion

similar to that of scratching, and takes the wool off the cards lengthwise in respect to the fibres, or staple, producing a continued line loosely cohering, called the rove or roving. This rove, yet very loosely twisted, is then received or drawn into a whirling canister, and is rolled by a whirling motion in spiral lines within it, being yet too tender for the spindles. It is then passed between two pair of rollers: the second pair moving faster than the first lengthen the thread with greater equality than can be done by the hand. It is then twisted on poles or bobbins.

It may be useful here to notice a mistaken opinion, which prevails amongst very ignorant people, that no improvements in machinery, which tend to shorten hand labour, should be allowed.

It is more necessary that every one should have a right notion upon this subject, because in a manufacturing country like ours, inventions of this sort are every day made, and though the effect of them has always been, and must always be, to increase the wealth and comforts of all classes in society, it has nevertheless

been supposed to have a contrary tendency.

If a machine is invented, which enables one pair of hands to do the work of thirty, the consequence, they think, is to throw twenty-nine workmen out of bread, and under this erroneous notion, they have proceeded to acts of violence, and thus drawn on themselves the severest punishments.

Not many years ago, it was discovered by a person in Manchester, which is the great seat of the cotton manufacture in England, that cotton could be combed, carded, spun, and wove, as well and considerably cheaper by machinery, than by hand labour. An out-cry however was raised by the working class: they never considered that the immediate effect of this improvement would be to lower the price of cotton goods, and thus to cause them to be more worn, and of course to increase the sale of them. An industrious housewife, for example, could only afford from her own and her husband's earnings to buy herself an article of clothing as a gown or a cap; the new machine however lowers the price of the cotton, to half what it was before, and

the consequence is, that with the same sum she can buy two gowns or two caps. If the number of workmen, therefore, is lessened in one way, it must be increased in the other, because more cotton must now be prepared for the mill, and more workmen required also in other branches of the manufacture, which is still done by hand.

To take another instance, let us suppose that a machine was invented for weaving linen, and that the effect would be to lower the price to half what it sells for at present; this would bring it within the means of a greater number of people, and thus the quantity to be sold must be increased. Without taking into account the increased number of workmen, necessary for making these new machines, let us see what effect it will have on the manufacture of linen; more land must be brought into cultivation for flax; more hands will be required for drying, beetling, scutching, cloving, hackling and spinning it; more people must be employed in bleaching the cloth, and making it up for the dealer. The manufacturer will thus be enriched, whilst he gives employment and support to greater numbers than

before ; and if he is a good man he will use the riches with which providence has blessed his industry, in improving the condition of those around him.

Supposing, however, that a new invention in machinery did throw the work people out of employment in a cotton mill ; those who are really industrious need never be without employment ; those who spun or wove can now dig, and cultivate the ground. In the north of Ireland, where every weaver is a small farmer, if the harvest be bad, he applies more sedulously to his loom ; if his flax fails, he cultivates his little spot of ground with double diligence. In the same way, no man needs be idle whilst there are so many wants in the world. As machinery improves our manufactures, there will always be more people required to produce and prepare the article in question ; more things to carry from place to place ; more houses to be built ; and, in a word, more labour in general than there was before ; and a man's refusing to get a livelihood by some kind of labour, will always mark the differ-

ence between the wicked who deserve punishment, and the industrious.

But there is another way of considering this subject, which should never be lost sight of. No master can be obliged to hire more workmen than he has occasion for, he has free power to use his understanding (which is a gift of God) in improving his tools and machines; he is master of his own property, and if we attempt to deprive him of it, we are guilty of a heinous sin, which the laws, that protect both rich and poor, most probably, and which the Almighty most assuredly, will punish. There is a future state in which we must all account for our actions in this life, where the punishment of wickedness is as certain as the reward of piety and virtue.

The fabrics made from cotton are probably more various and numerous than from any other material. They comprehend stuffs of all degrees of fineness, from the transparent muslin of a robe, to the thick and warm bed quilt. Nankeens which are manufactured in India, are made of a kind of cotton which is naturally of that colour. Cotton is capable also of being manufactured into paper,

though it is very inferior to that made from linen rags.

The commerce of Great Britain, has of late years been peculiarly indebted to the cotton manufactory, which produces clothing for people of all ranks, from Russia and America, to India and Africa, and unites elegance with cheapness in an unrivalled degree. Great quantities of the native fabrics of the East are also imported into Europe. Some of these, by the advantage of an excellent material, and incomparable manual dexterity and patience in the workmen, though made with very simple machinery, surpass in fineness and beauty any thing of European manufactory. The natives are said to perform their finest work in moist cool places under ground, which makes the cotton hold together, so as to draw out to the finest threads; and the soft and delicate fingers of the Indian women, give them the sense of feeling to a degree of nicety, much beyond that of our common people.

It is probable, that cotton at present, clothes more people in the world than any other substance. Its peculiar advantage, besides cheapness, is the union of warmth

with lightness, whence it is fitted for a great variety of climates. To the hot, it is better adapted than linen, on account of its absorbing quality, which keeps the skin dry and comfortable. The woolliness of cotton gives a kind of nap to the clothes made of it, which renders them soft to the touch, but apt to attract dust. In the fine muslins this is burned off, by passing them between heated cylinders, with such velocity as not to take fire, which may be conceived, considering the combustibility of cotton, to be a very nice operation. A readiness to catch fire is, indeed, a dangerous quality of this material, and many fatal accidents have arisen from it since the prevailing use among the rich of muslins in womens' dress. Much mischief has also proceeded from colds taken in these delicate garments, which are by no means fitted to protect the wearer from the inclemencies of our variable climate.

On the average of the last ten years, it is computed that seventy-three millions of pounds of cotton have been annually imported into England ; the cost of which in this its raw state, was about five millions sterling. When the cotton has been

manufactured into different kinds of stuffs, it is sold for thirty-five millions, the labour employed upon it increasing its value seven times. Consider now, how many other manufactures receive activity from this; it encourages the working of the coal, tin, lead, and copper mines; the trade in timber, tallow, &c.; the manufacture of glass, cards, leather, vegetable oil, and the preparation of all the necessaries of life required by those who are occupied in the cotton trade.

The downy matter surrounding the seeds in some other plants has been employed for the same purpose as cotton, and by proper preparation has, in some instances, succeeded very well, but, in most cases, it is too brittle, or of too short a staple, to be used with advantage in the form of thread. It has, however, afforded an useful material for stuffing beds and pillows, and for quilting. In this way the down of a plant growing copiously upon some of our bogs, called cotton-grass, has been employed by the neighbouring poor.

OF CALICO-PRINTING.

CALICO printing is the art of communicating different colours to particular spots or figures, on the surface of cotton or linen cloth, whilst the rest of the stuff retains its original whiteness.

This ingenious art has been practiced in India for above two thousand years. One hundred years ago it was scarcely known in Europe, and yet at this day, it may almost be said to have arrived at perfection, whether we consider the elegance of the patterns, the beauty and permanency of the colours, or the expedition with which the different operations are carried on.

Calico Printing consists in covering those parts of the cloth which are to receive a colour, with a liquor called a mordant, and then dying it as usual with some dye stuff or other.—The dye stuff attaches itself firmly only to that part of the cloth which has received the mordant liquor, which hence receives its name, because it unites with, and holds fast the colour thus applied :—The whole surface



CALICO PRINTING.

of the cotton is indeed more or less tinged, but by washing it and bleaching it for some days on the grass, with the wrong side uppermost, all the parts that have not received the mordant resume their original colour, while the others retain the colour communicated. But it will be necessary to explain this to the young reader more minutely.

Before the calicos are printed, they must be prepared by being bleached in a similar manner to that described in the account of the linen manufacture, excepting that the different operations are not so frequently repeated, as cotton goods are more easily whitened than linen. After being taken up dry from the bleach green, they are smoothed by means of a piece of machinery called a calender : This consists of two or more revolving cylinders closely pressed together, one of them is made of wood and the others of metal, or paper, the polished surface of which impresses a corresponding gloss on the calico, as it is passed between them. A person attends to keep the wrinkles smoothed out, as the calico is drawn in between the cylinders, and another laps the cloth into convenient folds for the printer as it passes from the calender.

As the stamp or printing block, with which the pattern is impressed on the cloth, engages much ingenuity in its construction, it may not be uninteresting to our readers to describe the mode of its preparation. The pattern is first designed and painted on paper: this is generally the work of a different artist from him who makes the print. A block of wood of a suitable size, generally about nine inches by seven, and two inches thick, is provided, the face of the block is generally made of holly, sycamore, pear-tree, or box-wood, and the bark of some kind of wood which will bear hard strokes of a mallet without receiving much injury. The face being planed smooth, the design is first painted on it from the pattern with carmine colour. This marks so much of the face of the block as is to be left, and forms the outline of the pattern. The parts between these the cutter skillfully scoops out, with a number of curiously shaped instruments, like chisels, lances &c. he also cuts holes in the back of the block, by which the printer can introduce his thumb and fingers to hold it. Sometimes the prints are formed in a different manner: the pattern being painted on the face,

instead of cutting away the wood, little pieces of brass and copper, having corresponding shapes with the pattern, are stuck into those places where the pattern is to be formed.

We shall now describe the operations of printing and finishing a piece of calico, with a red sprig on a white ground : and subjoin a few observations, from which the reader may infer the mode of doing a variety of other colours and combinations of colour.

The operation of printing is performed in a room heated by a stove, in order that the work may dry speedily when done. The compositions which are printed on, although technically called colours, are in general only preparations which enable the cloth to take the colours in a subsequent operation ; they are properly called mordants, because, as the word expresses, they gripe and hold fast the colours afterward applied. For reds and yellows the mordant is composed of a preparation of alum and a sort of vinegar, made into a paste with wheat flour, and coloured red or yellow by the infusion of some red or yellow dye stuff : but it must be obs-

served, that this colouring of the mordant does not contribute to the future colour of the pattern, but is used merely to enable the printer to see his work, to judge if he is laying on the proper quantity of mordant and doing it evenly.

The printer works at a table made of stone, the surface of which is perfectly even and covered with a soft blanket; on this he spreads the calico to be printed, and having covered the pattern with the necessary quantity of mordant liquor, he stamps an impression of the pattern on the cloth, by striking the block on the back with a mallet. In this manner he proceeds, carefully joining the impression which he is about to lay, with those which are already done, till he has printed the whole surface of the cloth on the table: this is then drawn off, and hung up to dry at the end of the table, it being covered with another length of the unfinished cloth, which is printed in a similar manner; and so the work proceeds till the piece is finished.

The calico is then hung up for a few days in a warm stove, to make the mordant combine more intimately with the cloth, after which it is taken down to undergo the rinsing operation. This consists of

working it in a luke-warm bath of cow-dung and water, for fifteen or twenty minutes. It would be difficult to assign a satisfactory reason for the superior efficacy of cow-dung in this operation, above every other substance which has been tried, but the use of it is justified by the fact of its contributing more than any other substance to produce a rich full colour, and a clear white ground. The rinsing is done by means of a kind of reel, placed over a copper boiler, and turned by a winch or handles. The end of the piece being laid on the reel, it is turned pretty quick, and draws up the piece at one side and lets it fall down in the other side of the boiler. When the workman arrives at the end of the piece, he turns the reel the contrary way, and thereby works the piece back; and so proceeds till he judges it sufficiently done. This operation softens and removes the paste and superfluous mordant, which otherwise would be prejudicial to the dying process which succeeds.

When the piece is sufficiently rinsed, it is taken from the boiler and washed. The washing operation, which is the next part of the process, is performed by

a machine called a wash-wheel, worked by means of a water wheel or other moving power. It consists of a revolving drum, about six feet in diameter, having four chambers in it, formed by partitions proceeding from the centre to the circumference, in each of which a piece of calico is put to be washed : while the wheel revolves, a jet of clean water is constantly spouting into it, and each piece, being successively drawn up at the circumference of the wheel nearly to the top, drops down on the lowest, part of the chamber with considerable force. This continued tossing about of the pieces under a jet of clear water, soon frees them from all impurity, and no appearance of the pattern is visible on the cloth,

In the next operation, which is the dying ; the calico is put in a boiler charged with cold water and ground madder, which is a root imported from Holland, Turkey and the East Indies. The fire under the boiler is gradually raised so as to bring the liquor to a boil in about three hours : the calico being kept constantly moving back and forwards over a reel during this time, the pattern appears of a full bright red colour, while those parts of the cloth on which none of

the mordant was printed, have imbibed but a slight tinge of colour from the die-stuff. The calico is now taken from the boiler, and being afterwards repeatedly washed in cold water and boiled in bran and water, these operations remove almost all the colour from the parts which have not previously been stamped with the mordant liquor, without doing injury to the remainder. The piece is then pressed, in order to squeeze out all the water, and being spread upon the grass for a few days, the exposure to the sun and air, bleaches the white ground perfectly, leaving the pattern of a beautiful red colour. It is then taken off the grass and starched, which fits it for receiving a high degree of gloss in the subsequent operation of calendering. It is lastly folded up, and pressed; after which it is in a state fit for the market.

Single coloured patterns are generally, however, printed by machinery, this mode being not only cheaper and more expeditious, but much neater than with the printing block. A printer at the table can sometime print 150 yards per day, whilst by the printing machine 7000 yards may be printed. The essential parts of

this machine are a copper roller, on which the pattern is engraved; beneath this is a roller which turns in a box of mordant, and rubs against the engraved roller, thereby smearing it with the mordant. A thin elastic plate of steel pressing against the copper, a little above the part where it is in contact with the mordant roller, scrapes off the superfluous liquor, leaving the engraved parts of the copper filled; on the top of the copper a roller covered with soft blanket is pressed with considerable force. The calico passing between this and the engraved roller receives the mordant from the latter, and from thence passes into a stove where it is dried.

If the cloth instead of being printed with the preparation of alum had been printed with a proper solution of iron of sufficient strength, the treatment before described would have produced a black colour; a weaker solution of iron would produce a purple; and a still weaker solution a black colour. In a similar manner, if the solution of alum be varied in strength, different shades of red may be produced. A mixture of alum and iron solution, properly proportioned, makes a chocolate, or brownish red

colour. Hence in chintz-work a black colour, together with four different shades of red, and three shades of purple, are all dyed at one operation and with but one kind of die-stuff-madder. When a number of different colours are introduced in the same pattern, there is a separate block required for each colour, on which is cut all those parts of the pattern designed to be of the same colour, and they are all so contrived as when properly stamped on cloth, to make each colour fall with precision upon the place designed, without interfering with each other. In laying on the mordants for the different colours, the workman generally begins with the black, and having gone over the whole piece, he then prints in the next darkest colour, and so proceeds nearly in the order of the depth of colour till all be printed.

After the chintz work is died with madder, and the white grounds cleared with branning and by exposure on the grass, the calico being again calendered, a solution of indigo is printed on those parts designed to be blue and green. Washing in clean water removes the superfluous parts of the solution, and the blue colour

appears in its full brilliancy. After this, the calico is again brought to the printer, and the mordants are printed into those parts of the pattern designed to be yellow and olive, or drab colour. The mordants for these are the same as for red and purple, but instead of being died with madder they are died with the bark of a species of oak tree which grows in North America, and which with the alum mordant makes a rich bright colour. The yellow mordant being put in some places over the blue, forms a green when dyed, and in other places when laid upon a pale shade of red, it makes an orange, and in this manner by a judicious admixture of a few colours, a considerable variety is produced.

Various other modes of forming coloured patterns on cotton cloth are in use. Sometimes the cloth is entirely impregnated with a mordant, and afterwards a pattern is produced by printing on a solvent which removes the mordant where applied; afterwards the cloth being died, white figures appear on a coloured ground. Sometimes the cloth is died an uniform even colour, and the pattern is produced by destroying or

removing the colour from the figured parts.

In some cases, the cloth being died an uniform dark colour with iron for the mordant, a light figure is formed by the application of a different mordant, which uniting with the cloth and die-stuff dispossesses the iron. If the original dark colour had been died with American bark, a yellow may be produced in this way on it; or a red, if madder had been used.

Blue grounds, with white figures, are done in a different manner. The pattern being printed on with a peculiar composition, the cloth is hooked in a frame, so that in no place does one fold of the cloth, touch another. The frame is then immersed in a solution of indigo for a few minutes: being lifted out, it is allowed to stand a few minutes exposed to the air: then dipped again in the indigo, and so on alternately dipping and airing till the colour be sufficiently deep. The indigo does not penetrate the composition, and when this is afterwards washed off, the pattern appears with beautiful distinctness.

A pure solution of iron properly made

up, and printed on the cloth, appears of a brownish colour: if it be rinsed in lime water, a rich and permanent buff colour is produced.

If a piece of calico impregnated with the iron mordant, be worked in a solution of a certain salt called prussiate of pot ash, the iron is converted to a beautiful blue colour.



THE MANUFACTURE OF WOOL.

OF all the materials for clothing afforded by animals, the wool of the sheep has been preferred by the greatest number of people in all ages. This useful and innocent creature has been domesticated in all the climates of the globe, between the extremes of heat and cold ; and in all, it has not only bestowed upon man its flesh for his nourishment, but its fleece for his covering. The skin, with the wool growing to it, has been the dress only of savages, or of tribes little advanced beyond them, but wherever civilization has prevailed, the wool, plucked off or sheared from the skin, has been employed as a material for the fabrication of cloths of different kinds. This wool, may be taken from the living animal at the approach of summer, without hurting it, and is annually renewed.—Sheep-shearing is one of the most interesting of the rural occupations, and has afforded a subject of pleasing description to several poets, particularly to Dyer,

whose principal poem is entitled the Fleece, and to Thomson, the author of the Seasons.

Wool differs from common hair, in being more soft and supple, and more disposed to curl. These properties it owes to a degree of unctuousity, or greasiness, which is difficultly separated from it. Its qualities, in respect to fineness, length of staple, colour, &c., differ greatly in different breeds of sheep, and even in different parts of the same fleece. Peculiar attention has been paid to the selecting of such breeds as yield the best wool for different purposes, and treating the animal so as to improve it to the highest degree. The wool brought from Vigonia in Spain, is allowed to be the finest that Europe affords. In that country there are frequently seen ten thousand sheep in a flock, and the number of shepherds to attend them not less than fifty. They have a description of dog called a sheep-dog, which assists them much in tending such a great number. This careful animal which is remarkable for its sagacity, prevents the flock from straying, and almost acts the part of a shepherd.— They pasture in the mountains during sum-

mer but are always driven into the plain where they remain the whole of winter. Probably some of the English kinds excel all others in length of flake. There is, indeed, no kind of wool, of which very good samples are not to be found in these islands, for no where have more pains been taken to vary and improve the breeds of sheep.

Before shearing, the sheep undergo the operation of washing, in order to free the wool from the foulness which it has contracted ; it is thus described by Dyer.

On the bank
 Of a clear river, gently drive the flock,
 And plunge them one by one into the flood :
 Plung'd in the flood ; not long the struggler sinks
 With his white flakes, that glisten thro' the tides ;
 The sturdy rustic, in the middle wave,
 Awaits to seize him rising ; one arm bears
 His lifted head above the limpid stream,
 While the full clammy fleece, the other laves
 Around, laborious, with repeated toil,
 And then resigns him to the sunny bank,
 Where, bleating loud, he shakes his dripping locks.

The shearing itself is conducted with a degree of ceremony and rural dignity, being a festival, as well as a piece of labour.

At last, of snowy white, the gather'd flocks
 Are in the wattled pen innumeros press'd,
 Head above head : and, rang'd in lusty rows,
 The shepherds sit, and whet the sounding shears.
 The housewife waits to roll her fleecy stores,
 With all her gay-drest maids attending round.
 One, chief, in gracious dignity enthron'd,
 Shines o'er the rest, the past'ral queen, and rays
 Her smiles, sweet-beaming, on her shepherd king.
 A simple scene ! yet hence BRITANNIA sees
 Her solid grandeur rise, hence she commands
 Th'exalted stores of every brighter clime,
 The treasures of the sun, without his rage.

THOMSON.

The whole wool, as taken from the animal's body, is called a fleece. The first operation this undergoes is that of picking and sorting, into the different kinds of which it is composed. These are next to be cleansed from marks and stains, and freed from their offensive greasiness. The practice of using tar in marking sheep, and also in dressing their sores, is the cause of the waste of much wool, from the difficulty of getting it out again, and should therefore be avoided as much as possible. When the wool is cleansed, it is delivered to the wool-comber, who, by means of iron-spiked combs

of different fineness, draw out the fibres, smooth and straighten them, separate the refuse, and bring it into a state fit for the spinner. This operation is sometimes facilitated by the use of a good deal of oil, which is afterwards to be washed out. The spinner forms the wool into threads, which are more or less twisted, according to the manufacture for which they are designed. The more twisted is called worsted, the looser, yarn. Combed wool when spun is used for hosiery and stuffs; that employed in the manufacture of cloths, blankets, &c. is not combed but carded merely in the same manner as cotton.

The kinds of stuffs made wholly or partly of wool are extremely various; and Great Britain produces more of them, and in general of better quality, than any other country in Europe. Our broad cloths form the principal article of the dress of men of the superior classes; and a more perfect manufacture, with respect to beauty and utility, cannot easily be conceived. The threads in it are so concealed by a fine nap or down raised on the surface, and curiously smoothed and glossed, that it looks more like a rich tex-

ture of nature's forming, than the work of man. It is to be observed, that wool, in common with other animal substances, takes a die better than vegetable matters. Our clothes are therefore of every hue that can be desired; but, in order to fit the fleece of the cloth for the dier, they must be first freed from all greasiness and foulness. This is done by the operation of fulling, in which the cloths are beaten by heavy mallets, as they lie in water with which a quantity of clayey earth has been mixed. The best earth for this purpose is called fuller's earth, of which there are pits in several parts of England.—It unites like soap with the greasy matter, and renders it soluble in water; so that, by continually supplying fresh streams while the beating is going on, all the foulness is at length carried off. Most persons have probably seen fuller's-earth employed in a small way, in getting the grease-spots out of thin clothes. The operation of fulling has the farther effect of thickening the cloth, and rendering it more firm and compact, by mixing the threads with each other, something in the manner of a felt.

Cloths are made of all qualities as to

strength and thickness. Some of those used for great-coats, by their substance and shagginess, resemble the original fleece, or rather the fur of a bear, and render unnecessary the use of furred garments among us. Indeed, with the single material of wool, art has been able much better to suit the different wants of man in his clothing, than can be done by all the productions of nature. What could be so comfortable for our beds as blankets? What so warm, and at the same time so light, for old and palsied limbs as flannel? The several kinds of the worsted manufacture are excellent for that elasticity, which makes them sit close to a part without impeding its motions. This quality is particularly observable in stockings, of which article of dress, most of those worn by the inferior classes, and, in winter, by the superior, are made of worsted. The making of these, by the simple machinery of knitting, is a common domestic manufacture. In Scotland, knitting stockings is not confined to women, the men, also, who tend cattle in the fields, can use their knitting needles with equal dexterity; and it were much to be wished that our countrymen,

whose business leaves their hands free, would imitate the Scotch in learning this useful and industrious occupation.

In the large way, stockings are wrought by a curious engine, called a frame.— Even the thinnest of the woollen fabrics possesses a considerable degree of warmth, as appears in those very delicate cloths called shawls. The real shawls are made of the fine silky wool of Tibet, in the eastern part of Asia, and are sold in some instances so high as one hundred and fifty guineas each; hence though far superior to any other in strength, lightness, and warmth, the Cashmire shawls are worn only by the wealthy. They have, however, been well imitated by the product of some of our English looms.

A very different article made of wool, yet equally appropriated to luxury, is carpeting. This is rather clothing for our floors than ourselves, but our feet receive the benefit of its warmth. In the East, soft carpeting is placed round the room, upon which the natives recline or sit cross-legged, instead of using chairs; and the beauty and richness of their carpets is a principal part of their domestic finery.

Another article of no less convenience than any we have mentioned as manufactured from wool, is the felt hat which defends the head from the weather.— Every man knows the comfort derived from this little covering, which keeps off the rain in winter and the sun in summer.

It has already been remarked, that the use of linen, or cotton garments next to the skin, instead of woollen, is an improvement, since wool has always somewhat of a fretting, irritating quality, causing itching and eruptions. Hence it should never touch naked wounds or sores. In cold and damp countries, indeed, flannel keeps up an equable warmth and dryness, which is very salutary; and, on that account, it has been much recommended for delicate constitutions. Upon the whole, Dyer's praise of wool seems to have a just foundation. Speaking of materials for clothing, he says,

Still shall o'er all prevail the shepherd's stores,
For num'rous uses known: none yield such warmth,
Such beauteous hues receive, so long endure:
So pliant to the loom, so various, none

OF THE SILK MANUFACTURE.

MEN must have been far advanced in civilization, and the observation of nature, before they found out a material for clothing in the labours of the caterpillar. China, one of the oldest-peopled countries of the globe, and in which the arts of life have longest arrived at a high degree of perfection, appears to have been the first to make use of the web spun by the silkworm. This creature, which, in its perfect state, is a kind of moth, is hatched from the egg, in the form of a caterpillar, and passes from that state successively to those of a nymph or chrysalis, and of a winged insect. While a caterpillar, it eats voraciously, its proper and favourite food being the leaves of the different species of mulberry tree. By this diet it is not only nourished, but is enabled to lay up, in receptacles within its body formed for the purpose, a kind of transparent glue, which has the property of hardening as soon as it comes into the air. When arrived at full maturity, it

spins itself a web out of this gluey matter, within which it is to lie safe and concealed during its transformation into the helpless and motionless state of a chrysalis.

It may here be remarked, that there is not in nature a more striking example of what is called instinct in animals, than this fact of the webs spun by most of the caterpillar tribe. By instinct is meant an impulse to actions, of which the end or purpose is not foreseen by the performer, and which are not the consequence of instruction or imitation. Now, the caterpillar has never been taught by a parent, since it has not been hatched from the egg till many months after all of its species are dead. Nor can it possibly discern any use in spinning itself a temporary tomb, which it is to occupy under a new state of being. It works, therefore, in consequence of an impulse given to it, by the Creator directing its plan and motions, for which we have no other name than that of an instinct.

The silk-worm's web is an oval ball, called a cocoon, about the size of a pigeon's egg, formed of the silk which is spun by the animal, and within which, as

has been mentioned, the animal encloses itself. When we intend to separate the silk from the ball or cocoon, a downy matter on the outside which we call floss, must be cleared away in the first place; and the cones, with their silk, are then thrown into warm water; where they are stirred about with twigs, in order to come at the heads or the beginnings of the silk. These are drawn through little rings, to prevent the cones from rising too high, when the silk is fastened to the reel, and you begin to wind it. They also join together the silk of several cones, to a certain number, as six, but generally eight, and sometimes more, according as the silk is intended to be made more or less strong. This is the silk in its natural state, called raw silk. It undergoes some operations to cleanse and render it more supple; after which it is made into what is called organzine or thrown silk, being twisted into thread of such different degrees of fineness as are wanted in the different manufactures. This is done in the large way by mills of curious construction, which turn at once a vast number of spindles, and perform, at the same time, the processes of unwinding,

twisting, reeling, &c. The largest and most ingenious machines for this purpose, are at Derby, in the West of England, the country in which all the different branches of the silk manufacture are carried on.

The great recommendation of silk, as an article of clothing, consists in its strength, its lightness, beauty, and readiness in taking the different tinges of colour which the dier can give them; it is, likewise, not liable to be preyed on by insects. Before it came into such extensive use as at present, it was highly prized for its rarity; it is now esteemed for its many valuable qualities; but as it can never be produced in great abundance, it must always be a dear article of clothing. Silk-worms are reared from China quite through all the warm and temperate climates of Asia, and in the southern parts of Europe. France is the most northern country in which silk is produced in any quantity. In England, though silk-worms are bred without much difficulty, by way of experiment, yet the dearness of labour prevents the production of silk from being an object of profit. What is used in our manufactures, comes chiefly from Bengal, China, Persia, Lesser Asia, and

Italy, in a raw state, and from the last mentioned country, we receive that which is organzined. The fabrics of silk are very numerous, and almost all devoted to the purposes of show and luxury. In thickness, they vary from the finest gauze, to velvet, the pile of which renders it as close and warm as a fur. Some of the most beautiful of the silk manufactures are the glossy satten; the elegant damask, of which the flowers are of the same hue with the piece, and only shew themselves from the difference of shade; the rich brocade, in which flowers of natural colours, or of gold and silver thread, are interwoven; and the infinitely varied ribbons. It is also a common material for stockings, gloves, buttons, strings, &c. in which its durability almost compensates for its dearness. Much is used for the purpose of sewing, no other thread approaching it in strength. Silk, in short, bears the same superiority among clothing materials, that gold does among metals: it gives an appearance of richness wherever it is employed, and confers a real value. Even the refuse of silk is carefully collected, and serves for useful purposes. The down about the cocoons, and the waste separated in the operations

which raw silk undergoes, are spun into a coarser thread, of which very serviceable stockings are made. The interior part of the cocoon is reckoned to be the best material for making artificial flowers.

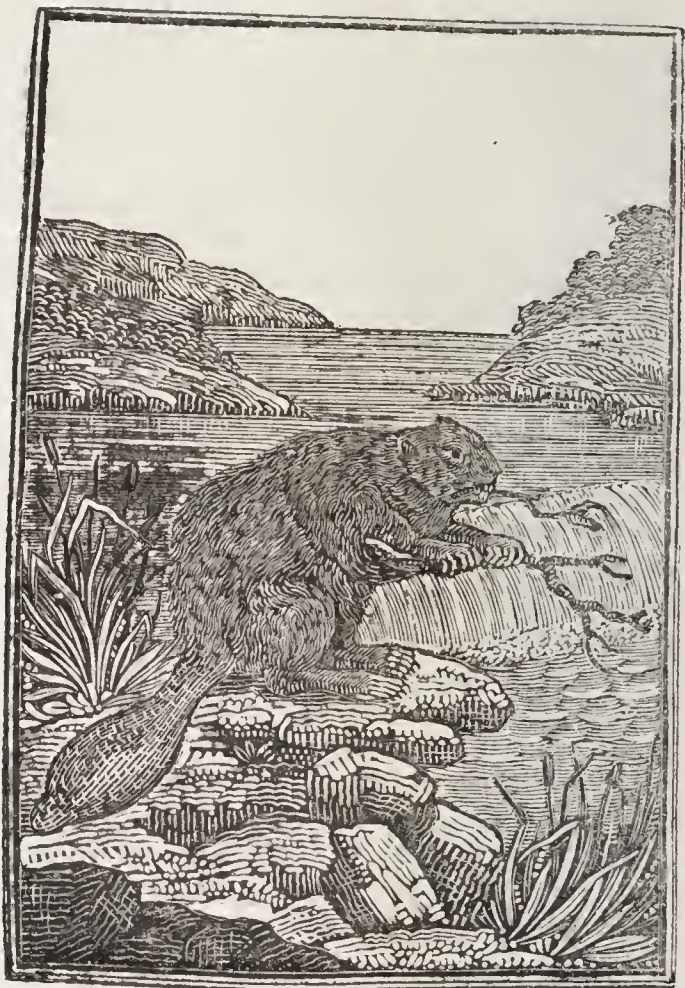
As it has been mentioned that the greatest part of the catterpillar tribe spin themselves similar webs, it may perhaps, be a matter of surprise that none of these have been employed like that of the silk-worm. The secret has in fact, been discovered of preparing silk from spiders' webs, but it never could be procured in sufficient quantity to render it an object of attention. A short account, however, of the attempt that was made in France, to turn the labour of this insect to human advantage, will be interesting.

During the early part of the last century, a project was entertained by a French gentleman, Mr. Bon, of Montpellier, of instituting a manufactory of spiders' silk; and the Royal Academy, to which the scheme was proposed, appointed the ingenious Reaumur to report the experiments of Mr. Bon, in order to ascertain how far the proposed plan might be carried; but after making the proper trials, Mr. Reaumur found it to be impracticable, on account of the natural dis-

position of these animals, which is such, as will by no means admit of their living peaceably together in large numbers. Mr. Reaumur also computed, that 663,522 spiders, would scarcely furnish a single pound of silk. Mr. Bon, however, the first projector, carried his experiments so far, as to obtain two or three pair of stockings and gloves of this silk, which were of an elegant gray colour, and were presented as samples to the Royal Academy. It must be observed, that in this manufacture, it is the silk of the egg-bags alone that can be used, being far stronger than that of the webs. Mr. Bon collected twelve or thirteen ounces of these, and having caused them to be well cleaned of dust, by properly beating with sticks, he washed them perfectly clean in warm water. After this, they were laid to steep in a large vessel, with soap, salt petre, and gum arabic. The whole was left to boil over a gentle fire for three hours and a half, and afterwards washed again to get out the soap; then laid to dry for some days; after which they were carded, but with much smaller cards than ordinary. The silk is easily spun into a fine and strong thread; the difficulty being only to collect the silk-bags in sufficient quantity.

Mr. Reaumur, among his objections, states, that the thread, notwithstanding Mr. Bon's description, is far inferior to that of the silk-worm, both in lustre and strength. The thread of the spider's web, according to this author, bears a weight of only twelve grains, without breaking whereas that of the silk-worm bears the weight of thirty-six.

But it is not alone from the silk-worm and the spider, that silk for clothing and ornament have been prepared: it will surprise the young reader to learn, that the product of a shell-fish, which lives at the bottom of the sea, has actually been employed for the same purpose. The one we speak of, is a kind of large muscle, called Pinna, found on the coasts bordering the Mediteranean Sea, which by means of some wonderful contrivance, has the power of spinning from its body a quantity of fine brown silky threads, by which it fastens its shells firmly to the rocks. These threads collected are woven into stockings, gloves, and other articles, and sold by the people on these shores.



THE BEAVER.

HAT MAKING.

HATS are made either of wool, or hair of different animals, particularly of the beaver, rabbit, and goat; but as this last is conveyed to the ports of Smyrna, Aleppo, &c. on camels, it takes the name of camels' hair. The process is nearly the same in all; it will, therefore, be sufficient if we describe the method made use of in the manufacture of beaver hats; but we shall previously make the young reader acquainted with the very remarkable animal which furnishes the material; indeed, its history is so surprising, that we might find it difficult to believe, if we had not the assurance of persons of the greatest veracity, that however surprising may be the circumstances, they are nevertheless true.

The general length of the beaver is about three feet; the tail is oval, nearly a foot long, and flattened; its figure such as is represented in the plate.

Beavers generally live in communities, consisting of as many as two or three hundred individuals; and inhabiting extensive

dwelling, which they raise to the height of six or eight feet above the surface of the water. They select, if possible, a large pond, in which they raise their houses on piles, forming them either of a circular or oval shape, with arched tops; thus giving them, on the outside, the appearance of a dome, while within, they somewhat resemble an oven. The number of houses is, in general, from ten to thirty. If the animals cannot find a pond to their liking, they fix on some flat piece of ground, with a stream running through it; and in making this a suitable place for their habitations, a degree of sagacity and intelligence, of design and memory, is exhibited, approaching, in an extraordinary degree to the faculties of the human race.

The first object is, to form a dam. To do this, it is necessary that they should stop the stream, and of course, that they should know in which direction it runs. This seems a very wonderful exertion of intellect; for they always do it in the most favourable place for their purpose, and never begin at a wrong part. They drive stakes, five or six feet long, into the ground, in different rows, and interweave

them with branches of trees ; filling them up with clay, stones, and sand ; which they ram so firmly down, that though the dams are frequently a hundred feet long, Captain Cartwright says, he has walked over them with the greatest safety. These are ten or twelve feet thick at the base ; gradually diminishing towards the top, which is seldom more than two or three feet across. They are exactly level from end to end ; perpendicular towards the stream, and sloped on the outside, where grass soon grows, and renders the earth more united.

The houses are constructed with the utmost ingenuity, of earth, stones, and sticks, cemented together, and plastered in the inside with surprising neatness. The walls are about two feet thick, and the floors so much higher than the surface of the water, as always to prevent them from being flooded. Some of the houses have only one floor : others have three. The number of beavers in each house is from two to thirty : these sleep on the floor, which is strewed with leaves and moss ; and each individual is said to have its own place. When they form a new settlement, they begin to build their

houses in the summer; and it costs them a whole season to finish the work, and lay in their winter provisions, consisting principally of bark and the tender branches of trees, cut into certain lengths, and piled in heaps under the water.

The houses have each no more than one opening, which is under the water, and always below the thickness of the ice. By this means they are secured from the effects of the frost.

The beavers seldom quit their residence unless they are disturbed, or their provisions fail. When they have continued in the same place three or four years, they frequently erect a new house; but sometimes merely repair their old one. It often happens, that they build a new house so close to the former dwelling, that they cut a communication from one to the other; and this may have given rise to the idea of their having several apartments.

During the summer time, they quit their houses, and ramble about from place to place, sleeping under the covert of bushes, near the water-side. On the least noise, they betake themselves to the water for security; and they have sentinels, who, by a certain cry, give notice of the ap-

proach of danger. In the winter they never stir out, except to their magazines under the water; and during that season, they become excessively fat.

At the head of one of the rivers of Louisiana, in a very retired place, M. du Pratz found a beaver dam. Not far from it, but hidden from the sight of the animals, he and his companions erected their hut, in order to watch their operations at leisure. They waited till the moon shone bright; and then, carrying in their hands branches of trees in order to conceal themselves, they went with great care and silence to the dam. Du Pratz ordered one of the men to cut, as silently as possible, a gutter, about a foot wide, through it; and retire immediately to the hiding place.

As soon as the water through the gutter began to make a noise, (says this writer,) we heard a beaver come from one of the huts, and plunge in. We saw him get upon the bank, and clearly perceived that he examined it. He then, with all his force, gave four distinct blows with his tail; when immediately the whole colony threw themselves into the water, and arrived upon the dam. As soon as they were assembled, one of them appeared,

by muttering, to issue some kind of orders ; for they all instantly left the place, and went out on the banks of the pond in different directions. Those nearest to us, were between our station and the dam, and therefore we could observe their operations very plainly. Some of them formed a substance resembling a kind of mortar ; others carried this on their tails, which served as sledges for the purpose. I observed that they put themselves two and two, and that each of a couple loaded his fellow. They trailed the mortar, which was pretty stiff, quite to the dam, where others were stationed to take it ; these put it into the gutter, and rammed it down with blows of their tails.

The noise of the water soon ceased, and the breach was completely repaired. One of the beavers then struck two blows with his tail ; and instantly they all took to the water without any noise, and disappeared.

M. du Pratz and his companions afterwards retired to their hut to rest, and did not again disturb these industrious animals till the next day. In the morning, however, they went to the dam, to see its construction ; for which purpose it was

necessary that they should cut part of it down. The depression of the water in consequence of this, together with the noise they made, roused the beavers again. The animals seemed much agitated: and one of them, in particular, was observed several times to approach the labourers, as if to examine what passed.—As M. du Pratz apprehended that they might run into the woods, if further disturbed, he advised his companions again to conceal themselves.

One of the beavers then ventured, (continues our observer,) to go upon the breach, after having several times approached and returned like a spy. He surveyed the place; and then struck four blows, as he did the preceding evening, with his tail. One of those that were going to work, passed close by me, and as I wanted a specimen to examine, I shot him. The noise of the gun made them all scamper off with greater speed than a hundred blows of the tail of the overseer could have done.—By firing at them several times afterwards, they were compelled to run with precipitation into the woods. M. du Pratz then examined their habitations.

Under one of the houses he found fifteen pieces of wood ; with the bark in part gnawed off, apparently intended for food. And round the middle of this house, which formed a passage for them to go in and out at, he found no less than fifteen different cells. These habitations were made by posts fixed, slanting upwards to a point ; and in the middle was the floor, resting firmly on notches in the posts.

The skin of the beaver is covered with two kinds of hair, the one long, stiff and glossy ; the other is short, thick-set and soft, and is alone used for hats.

To tear off one of these kinds of hair, and cut the other, women are employed, who make use of two knives : a large one something like a shoe-maker's knife, for the long hair, and a smaller one nearly in the form of a pruning knife, with which they shave or scrape off the shorter hair.

The materials for making hats are, as we have mentioned, rabbits' fur cut off from the skin, together with wool, and beaver ; to which have been lately introduced mole fur, and kid hair. These are mixed in various proportions, and of different qualities, according to the value of

the hats intended to be made; but the beaver is now wholly used for facing the finer hats, and not for the body or main stuff. Experience has shewn, that the hair or fur cannot be evenly and well felted together, unless all the fibres be first separated, or put into the same state with regard to each other. This is the object of the first process of hat-making, and is called *bowing*. The material is laid upon a platform of wood, or of wire, about four feet square, called a *hurdle*, which is fixed against the wall of the workshop. The hurdle is a table of wood, with chinks or slits in it, for the purpose of suffering the dust and other impurities of the stuff, to pass through; a purpose still more effectually answered by a hurdle of wire. The workman is provided with a bow, a bow-pin, a basket, and several cloths. The bow is a pole of deal or ash, about seven feet long, to which are fixed two bridges, somewhat like that which receives the hair in the bow of the violin. Over these is stretched a cat-gut, about one-twelfth of an inch in thickness. The bow-pin is a stick with a knob, and is used for plucking the bow-string. The basket is a square piece of

ozier-work, consisting of open straight bars, with no crossing or interweaving; its length across the bars two feet, and its breadth eighteen inches. The sides into which the bars are fixed, are slightly bent into a circular curve, so that the basket may be set upright on one of the edges near the right hand end of the hurdle, where it usually stands. The cloths are linen. Besides these implements, the workman is also provided with brown paper.

The *bowing* commences by shoveling the material towards the right-hand with the basket, upon which the workman, holding the bow horizontally in his left hand, and the bow-pin in his right, lightly places the bow-string, and gives it a pluck with the pin. The string, in its return, strikes upon the fur, and causes it to spring up in the hair, and fly partly across the hurdle in a light open form. By repeated strokes, the whole is thus subjected to the bow; and this beating is repeated till all the original clots or filaments are perfectly opened and dilated, and, having thus fallen together in all directions, form a thin mass of substance for the felt. The quantity thus treated at

once is called a *batt*, and never exceeds half the quantity required to make one hat.

When the batt is sufficiently bowed, it is ready for *hardening*; which term denotes the first commencement of felting. The prepared material, being evenly disposed on the hurdle, is first pressed down by the convex side of the basket, then covered with a cloth and pressed backwards and forwards successively in its various parts, by the hand of the workman. This pressure brings the hairs closer to each other, and multiplies their points of contact: by means of this motion therefore, they are twisted together, and the whole mass assumes a compact state.

When the felt has thus acquired the necessary firmness and consistence intended to be given to it by the abovementioned agitation and pressure, the cloth is taken off, and a sheet of paper, with one corner doubled in, so as to give it a triangular outline, is laid upon the batt, which last is folded over the paper as it lies, and its edges, meeting one over the other, form a conical cap. The joining is soon made good by pressure with the hands on the cloth. Another batt, ready hardened, is

in the next place laid on the hurdle, and the cap here mentioned placed upon it, with the joinings downwards. This last batt, being also folded up, will consequently have its place of junction directly opposite to that of the inner felt, which it must therefore greatly tend to strengthen. The principal part of the intended hat is thus put together, and now requires to be worked with the hands a considerable time upon the hurdle, the cloth being also occasionally sprinkled with clear water. During the whole of this operation, which is called *basoning*, a bason being the name given to a circular piece of cast metal, on which *wool* hats are worked after bowing, the felt becomes firmer and firmer, and contracts in its dimensions. It may easily be understood, that the chief use of the paper is to prevent the sides from felting together.

The basoning is followed by a still more effectual continuation of the felting, called *working*. This is done at an apparatus called a *battery*, consisting of a kettle (containing water slightly soured with sulphuric acid, or vitriol, to which, for beaver hats, a quantity of wine-lees, or the grounds of beer is added, or else plain

water for rinsing out), and eight planks of wood joined together in the form of a cone, from which the top has been sliced off and meeting in the kettle at the middle. The outer or upper edge of each plank is about two feet broad, and rises a little more than two feet and a half above the ground ; and the slope towards the kettle is considerably rapid, so that the whole battery is little more than six feet in diameter. In this liquor, heated rather higher than unpractised hands could bear, the felt is dipped from time to time, and worked on the planks ; before which, it is plunged gently into the boiling kettle till fully saturated with the liquor, which is called *soaking*. The imperfections of the felt present themselves in the course of this part of the work, to the eye of the workman, who picks out knots and other hard substances with a bodkin, and adds more fur upon all such parts as require strengthening. This added fur is patted down with a wet brush, and soon incorporates with the rest. The beaver for the nap is laid on towards the conclusion of this kind of working. The hat now possesses the form of a sugar-loaf, and the whole of the several actions it has

undergone, have converted it into a soft flexible felt, capable of being extended, though with some difficulty, in any or every direction ; therefore, the next thing to be done, is to give it the form required by the wearer. For this purpose, the workman turns up the edge or brim to the depth of about an inch and a-half, and then returns the point back again through the centre or axis of the cap, so far as not to take out this fold, but to produce another inner-fold of the same depth. The point being returned back again in the same manner, produces a third fold, and thus the workman proceeds, until the whole has acquired the appearance of a flat circular piece, consisting of a number of concentric undulations, rings, or folds, with the point in the centre. This is laid upon the plank, where the workman, keeping it wet with the liquor, pulls out the point with his fingers, and presses it down with his hand, at the same time turning it round on its centre in contact with the plank, till he has, by this means, rubbed out a flat portion equal to the intended crown of the hat. In the next place, he takes a block, to the crown of which he applies the flat central portion

of the felt, and by forcing a string down the sides of the block, causes the next part to assume the figure of the crown, which he continues to wet and work, until it has properly disposed itself round the block. The brim now appears like a flounced or puckered appendage round the edge of the crown; but the block being set upright on the plank, the requisite figure is soon given by working, rubbing, and extending this part. Water only is used in this operation of fashioning or blocking; at the conclusion of which, it is pressed out by the blunt edge of a copper implement, used for that purpose, called a *stamper*.

Previous to the dying, the nap of the hat is raised or loosened out with a wire-brush, or carding instrument. The fibres are too rotten after the dying to bear this operation. The dying materials are logwood, verdigrease, a little oakbark, and a mixture of iron and copper, known by the names of green copperas and blue vitriol. The hats are boiled with logwood, and afterwards immersed in the saline solution. The dyed hats are, in the next place, taken to the stiffening-shop. One workman assisted by a boy, does this part

of the business. He has two vessels, or boilers, one containing the grounds of strong beer, and the other containing melted glue, a little thinner than what is used by carpenters. The beer grounds are applied in the inside of the crown, to prevent the glue from coming through to the face, and also to give the requisite firmness, at a less expence than could be produced by glue alone. Were the glue to pass through the hat in different places, it would be more difficult to produce an even gloss upon the face in the subsequent finishing. The glue is therefore applied after the beer grounds are dried, and then only upon the lower face of the brim, and the inside of the crown. For this purpose, the hat is put into another hat, called a stiffening hat the crown of which is notched, or slit open in various directions. These are then placed in a hole in a deal-board, which supports the brim, and the glue is applied with a brush. In France, however, they use wine-lees instead of beer-grounds, and gum-water instead of glue.

The dry hat after this operation, is always stiff and its figure irregular. The last dressing is given by the application

of moisture and heat, and the use of the brush, and a hot iron as before mentioned, somewhat in the shape of that used by tailors, but shorter and broader on the face. The hat being softened by exposure to steam, is drawn upon a block, to which it is securely applied by the former method of forcing a string down from the crown to the commencement of the brim. The judgment of the workman is employed in moistening, brushing, and ironing the hat, in order to give and preserve the proper figure. The brim of the hat is now to be cut round, or when not intended to be of an equal width throughout, as is oftentimes the case for military hats, it is cut by means of a wooden or metallic pattern. The cut is made before the hat is quite finished, and is not carried entirely through; so that one of the last operations consists in tearing off the redundant part, which by that means leaves an edging of beaver round the external face of the brim. When the hat is completely finished, the crown is tied up in gauze paper, which is neatly ironed down. It is then ready for the subsequent operations of lining, &c. for sale.



THE CURRIER

LEATHER DRESSING.

WHEN we speak of the hide of animals, which man applies to the clothing of his own body, a difference must be always made between the covering of the skin and the skin itself. The former, as we have mentioned, is separated, from the sheep-skin for instance, and manufactured into woollen garments, to defend us from the cold. When the hair however is very fine, it is not detached from the skin, but being dried and dressed, is sold under the name of fur. It is chiefly the smaller animals which are provided with these thick and glossy coverings, and it is a remarkable instance of the wise adaptation of Providence, that they are found in the greatest plenty and perfection where they are most wanted, that is, in the cold and desert wilds of Siberia and North America.

—————THERE, beneath the shining waste,
The furry nations harbour : tipt with jet,
Fair ermines, spotless as the snows they press ;
Sables of glossy black ; and dark embrown'd,
Or beauteous streak'd with many a mingled hue,
Thousands besides, the costly pride of courts.

THOMSON.

They form the riches of these dreary regions, where, during several months in the year, the sun appears but for a short time in the day; and their value has tempted men to expose themselves to the greatest hardships from cold and hunger, while pursuing the chase, surrounded by perpetual frost and snow.

In this, which is the simplest form of preparation, the only object is to preserve the skin from decaying or putrefaction. In the smaller fur this is easily effected, by first cleansing them well, and then hanging them to dry in the wind:—the larger are besides dressed with bark juice on the inside. In this condition, they make the most costly dresses of courts, and serve for marks of dignity and distinction. The fur of a black fox is an ornament for princes in the North of Europe; and in our own country, the robes of our King, of the Nobility, and of the Judges of the land, are adorned with the spotless ermine.

But it is not of the smaller animals alone, that the skins are allowed to retain the hair, and prepared thus simply for use. The covering of the bear and the seal are also made use of; the former for

soldiers' caps, ladies' muffs, hammer-cloths for carriages, &c.—the latter for trunks, shot-pouches, and other conveniences.

The modes of hunting the bear are various; in the North-east of Asia, where he is found divested of all his ferocity, and living tame and gentle amongst the inhabitants, the Kamtschadale goes in quest of this animal, armed with a spear and club and a parcel of faggots. These last the bear takes from him one by one, and with them himself chokes up the entrance to his den. The mouth of the cavern being thus closed, the hunter breaks a hole through the top, and from thence transfixes his defenceless foe

But this is not the only instance, in which the ingenuity of the hunter has found out a mode of making the bear instrumental to his own destruction. In consequence of the well-known partiality of these animals for honey, the Russians sometimes fix to those trees where bees are hived, a heavy log of wood, at the end of a long string. When the unwieldy creature climbs up to get at the hive, he finds himself interrupted by the log; he pushes it aside, and attempts to pass it, but, in returning, it hits him such

a blow, that in a rage he flings it from him with greater force, which makes it return with increased violence; and he sometimes continues this, till he is either killed, or falls from the tree.

Another method adopted by the inhabitants of the mountainous parts of Siberia, to make the animal become his own destroyer, is still more extraordinary. They fasten a very heavy block to a rope, that terminates at the other end with a loop. This is laid near a steep precipice, in the path on which the bear is accustomed to go. On getting his neck into the noose, and finding himself impeded by the log, he takes it up in a rage, and, to free himself from it, throws it down the precipice: it naturally pulls the bear after it, and he is killed by the fall. Should this, however, accidentally not prove the case, he drags the block again up the mountain, and reiterates his efforts; till, with encreasing fury, he either sinks exhausted to the ground, or ends his life by a decisive plunge.

But the gun is the surest destroyer of these animals, and it is with that weapon that the hunter in North America and in Siberia supplies Europe with its skin.

The seal skin has been also mentioned as being useful in its dried state. This is furnished by an animal which lives in the ocean during the winter, but in summer dwells much on the shores. The hunting of it is a dangerous employment to the Finlander, though he is trained to it from his childhood. With one or two companions he trusts himself to the open sea in a small boat, and will often continue a month absent from his family—The following is an instance of the perils attending the hunting. A few years ago, two Finlanders set out in a boat together. Having got sight of some seals on a little floating island, they quitted their boat, and mounted the ice, moving on their hands and knees to get near them without being perceived. They had previously fastened their boat to the little island of ice which they disembarked upon : but while they were busily engaged in the pursuit, a gust of wind tore it away ; and meeting with other shoals, it was broken to pieces, and in a few minutes entirely disappeared. The hunters were aware of their danger only when it was too late. They were now left without help, without any resource, and without even a ray of

THE SEAL.



hope, on their floating island. They remained fourteen days on this frail territory. The heat, which diminished its bulk, and also its prominent surface, rendered their situation more alarming every moment. At last, when reduced to despair, and without a hope of escape, they discovered a sail. One of them stripped off his shirt, and suspended it on the muzzle of his gun. The signal was observed from the vessel, which was a whale-fisher. A boat was put out to assist them, and by this providential circumstance, they were saved from otherwise inevitable destruction.

But the Greenlander's mode of hunting this animal, deserves also to be related:—The Europeans, who go into the Greenland seas upon the whale-fishery, surround them with nets, and knock them on the head; but the Greenlanders, who are unprovided with so expensive an apparatus, destroy them in a different manner. One of these little men paddles away in his boat, and when he sees a seal asleep on the side of a rock, darts his lance, and that with such unerring aim, that he never fails to bury its point in the animal's side. The seal feeling itself wounded, instantly plunges from the top

of the rock, lance and all, into the sea, and dives to the bottom; but the lance has a bladder tied to one end, which keeps buoyant, and resists the animal's descent; so that, every time the seal rises to the top of the water, the Greenlander strikes it with his oar, until he at last dispatches it.

It is evident, however, that skins of large animals in this dried state, can never be extensively used as an article of clothing; to make them supple, soft, and at the same time not easily penetrated by water, it is necessary to impregnate them with ooze of bark, this is called the operation of *tanning*—which we shall now proceed briefly to describe.

The hide, taken off with due care by the skinner, is first thrown into a pit with water alone, in order to free it from dirt. After lying a day or two, it is placed upon a solid half cylinder of stone, called a beam, where it is cleared of any adhering fat or flesh. It is then put into a pit, containing a mixture of lime and water, in which it is kept about a fortnight. The intent of this is to swell and thicken the hide, and to loosen the hair. Being now replaced upon the beam, the hair is scraped

off; after which it is put into the proper tanning liquor, called the ooze, which is an infusion of coarsely powdered oak bark in water. The bark of the oak, as well as every other part of it, abounds in a strongly astringent matter; and it is the thorough impregnation with this, which preserves the hide from decay or putrefaction. Other vegetable astringents will equally serve the purpose, and are used in some countries; but, with us, none is found so strong and so plentiful as that yielded by the oak. A weaker ooze is first employed, and the hide is frequently turned and worked in it. It is then removed to a stronger; and, lastly, into the most powerful, with fresh bark: and these different steepings take up a considerable time, greater or less, according to the size of the hide and other circumstances. When, at length, it is thought to have imbibed enough of the astringent matter, the hide is taken out and hung upon a pole to drain, after which it is put upon a piece of wood with a convex surface, called a *horse*, on which it is stretched, and kept smooth and even. Finally, it is taken to the *drying house*, a covered building with

apertures for the free admission of air; and it is there hung up till it becomes completely dry; and thus the process of tanning is finished.

From the tanner, the hide or skin, if intended for lighter use, such as harness, and the upper leather of shoes, is consigned to the *Currier*, whose art is farther necessary in order to make it fit for these purposes. He first soaks it thoroughly in water, and then places it upon a *beam*, made of hard wood, with one side sloping and polished. He lays it with the grain side, or that on which the hair grew, inwards, and the flesh side outwards. He then, with a broad two-edged knife, having a handle at each end, shaves or pares the hide on the latter side, till all its inequalities are removed, and it is reduced to the degree of thinness required for use. After this operation, it is again put into water, then scoured, and rubbed with a polished stone. It is next besmeared with a kind of oil procured from sheep or deer skin, or made by boiling train oil and tallow together; the intention of which is to soften or supple it. A great part of its moisture is then evaporated by hanging it up in a drying-house

for some days. It is then differently treated, according as it is meant to be blacked or stained, or not. Without entering into minute particulars, it is enough to observe, that the astringent principle with which the leather has been impregnated in the tanning, renders nothing necessary except the application of a solution of vitriol of iron, at once to strike a deep black. This is laid on with a brush, generally on the grain side of the leather; and it afterwards undergoes the operation of giving it that roughness which is called the *grain*. This is performed by rubbing it in all directions with a fluted board. When leather is blackened on the flesh side, the colour is given by a mixture of lamp-black and oil. We often see shoemakers, however, purchase their leather unstained, and afterwards blacken it themselves.

When we consider the quantities of leather that are made use of for boots and shoes, we shall be inclined to think that there are few substances so serviceable to man; certainly no other substance could so well unite strength and suppleness, with the property of keeping out

water. Good shoes are one of the most necessary articles of dress, for health and comfort, to those who go much abroad ; nor has human industry, in many cases, more happily exerted itself, than in discovering the most perfect mode of answering the purposes required in this manufacture. The great length of the process, however, has put many persons upon experiments to abridge it ; but though this may, perhaps, be done to a certain degree, yet it is probable, that time, in this instance as in many others, effects what no substitute can do ; and that the long and numerous soakings are necessary, thoroughly to impregnate the hide with the preservative matter, without injury to its texture.

Leather is capable of being died of various colours besides black, by means of different drugs. Some leather is likewise dressed white, or of a tawny hae, as you see in leathern breeches. The hides principally used in the shoe manufacture, are those of neat-cattle, or the ox kind. For the more delicate work, the skins of the goat, dog, seal, and some other animals, are employed. For

leather-breeches, deer-skin is preferred by the rich, and by the poorer class, that of the sheep ; and the best tanned gloves are made with the same.





THE PAPER MAKER.

MANUFACTURE OF PAPER.

PAPER is as necessary to the printer as his types, or his printing-press; and, therefore, we must consider the invention of it as entitled to the gratitude of the world.—Indeed, the art of printing would be comparatively of little importance, unless we had such a substance to receive the impression of the letters; fortunately, also, for every one who is fond of reading—it is made from such an abundant material, as to supply sufficient quantities for the infinite number of books which are published every year.

Formerly paper was made from the inner bark of a cane, or reed, which grew in Egypt. The Talipot tree, also, in India, has a leaf of uncommon size, which is manufactured into a kind of paper, but to both of them there is this strong objection, that, these plants which flourish in particular parts only of the earth, could never supply the demand. Cotton paper also is but a rude and coarse material, unfit for many of the purposes to which linen paper is applicable. It is

true, the substance from which paper is made, is a plant like the others, but it has the superior recommendation, that it can be cultivated in all parts of the world ; that in the first instance, it affords us a most convenient article of clothing, and is never sent to the paper manufacturer till it is quite useless for every other purpose ; indeed a more common and less valuable substance cannot be conceived, than the remnants and fragments of our garments and linen, worn out, and otherwise incapable of being turned to use, and of which an abundant supply is continually furnished. Could it be supposed, that the paper of this book was once the stalk of that delicate flower we call the flax-plant, or, can any substance appear more different, than a flower and a sheet of paper ? Its first change was a most surprising one ! into the linen which is commonly worn next the body ; its second is not less wonderful, from the thready appearance of cloth, into the sheet of paper, in which no such texture is visible, but on the contrary, the substance is so fine and smooth and glossy, that it receives and retains the letters which are either printed or written on it. The des-

cription, therefore, of such an ingenious process, must be interesting; and we shall accordingly endeavour briefly to satisfy the reader's curiosity.

This delicate and beautiful substance is made, as has been mentioned, from worn-out rags, which, instead of throwing them into the fire as useless, every good house-wife puts into a bag kept for that purpose, and sells to those persons who make it their business to go about and collect them. These latter sell them to the rag-merchant, who gives from two-pence to four-pence a pound, according to their quality; and he, when he has got a sufficient quantity, disposes of them to the owner of the paper-mill. This last gives them first to women, to separate into five different sorts, agreeably to their different degrees of fineness. No. 1, for instance, being all linen, the remains of fine cloth, is used for making the finest paper; and No. 5, consisting of coarse canvas or of old ropes, may be bleached, but makes only coarse paper. The first three sorts are intended for writing and fine printing; the remainder for newspapers, and other inferior uses.

After the women have with a knife cut

out carefully all the seams, which they throw into a basket for other purposes, they put them into a dusting engine, a large circular wire sieve, where they receive some degree of cleansing. The rags are then conveyed to the mill. Here they were formerly beat to pieces with vast hammers, which rose and fell continually with a most tremendous noise, that could be heard at a great distance; but now they put the rags into a large trough or cistern, into which a pipe of clear water is constantly flowing. In this cistern is placed a cylinder, about two feet long, set thick round with rows of iron spikes, standing as near as they can to one another without touching. At the bottom of the trough there are corresponding rows of spikes. The cylinder is made to whirl round with inconceivable rapidity, and with these iron teeth rends and tears the cloth in every possible direction; till, by the assistance of the water, which continually flows through the cistern, it is thoroughly shredded, and reduced to a fine pulp like thin gruel; and, by the same process, all its impurities are cleansed away, and it is restored to its original whiteness. This process takes about six

hours. This fine pulp or gruel, is then put into a copper of warm water. It is the substance of paper, but the form must now be given it: for this purpose they use a mould; it is made of wire, strong one way, and crossed with finer. This mould they just dip horizontally into the copper, and take it out again. It has a little wooden frame on the edge, by means of which it retains as much of the pulp as is wanted for the thickness of the sheet, and the water runs off through the interstices of the wires, the pulp remaining behind. Another man instantly receives it, opens the frame, and turns out the thin sheet, which has now shape, but not consistence, upon soft felt, or blanket, which is placed on the ground to receive it. On the paper is placed another piece of felt or blanket, and then another sheet of paper; and so on, till they have made a pile of forty or fifty. They are then pressed with a large screw press, moved by a long lever, which forcibly squeezes the water out of them, and gives them immediate consistence.

There is still, however, a great deal to be done. The felts are taken off, and thrown on one side, and the paper on

the other, when it is dexterously taken up, with an instrument in the form of a T, three sheets at a time, and hung on lines to dry. There it hangs for a week or ten days, which likewise further whitens it; and any knots and roughness it may have, are picked off carefully by the women. It is then sized. Size is a kind of glue, made from the skins of animals, and without this preparation, the paper would not bear ink; it would run and blot as you see it does on blotting paper. The sheets are just dipped into the size, and taken out again. They are then hung up to dry, and when dry, taken to the furnishing-room, where they are examined anew, pressed in the dry presses, which gives them their last gloss and smoothness: counted up into quires, made up in reams, and sent to the stationer, from whom we have it. The whole process of paper-making takes up about three weeks.

Now that the process has been explained, let us ask the young readers, can any labour be more simple than that of reducing our worn out garments to a fine pulp in water, by a mill—Indeed so great is the dispatch in preparing the material, that five work-

men may furnish paper sufficient to occupy three thousand writers and transcribers ; and this even on the old plan of hand labour, but by the modern improvements of mills, where the paper is produced in one continued web, instead of sheet, a great portion of the labour is totally done away.

Every quire of paper consists of twenty-four sheets ; and each ream contains twenty quires.

Pasteboard is made in a similar way to that of paper ; it is also manufactured from old paper, which being put again into the pounding-mill and cleared of all impurities, is reduced to a pulp, and treated as that from linen rags.

Blotting-paper, and paper used for filtering liquids, is paper not sized, in which, therefore, the ink readily sinks or spreads. Brown paper is made from old ropes which have been picked and worked into a coarse pulp—and fancy coloured papers are made of coarse or coloured rags.

Wove or woven paper is made in moulds, the wires of which are exceedingly fine, of equal thickness, and woven or latticed one with another. The marks, therefore

of these are easily pressed out, so as to be scarcely visible.

Chinese paper, so remarkable for its peculiar delicacy, is of various sorts.—Some is made of the rind or bark of trees, especially of the mulberry and the elm, or else of the bamboo and cotton tree.—Each different province of that immense empire may, indeed, be said to make its own peculiar sort of paper. That of the bamboo, a species of the cane or reed, is made from the second bark, which is soft and white. It is beaten in fair water to a pulp, which is taken up in moulds of such a size, that sheets are sometimes made of twelve feet in length. These are afterwards dipped in alum-water, which renders the paper impenetrable by ink, and gives it the appearance of being varnished.—It is white, soft, and of a close texture, but although quite smooth, it breaks more easily than European paper; it is also so thin as to be soon worn out, and is, besides, very subject to destruction by worms.

OF TYPE-FOUNDING.

WHEN the paper has been thus manufactured, its utility commences. It is needless to remind the young reader of many of its applications.—It gives him the power of communicating his thoughts by letter, to those from whom he is separated—and oftentimes is the means of informing him that his parents, relatives, or friends, though thousands of miles distant, are in health and prosperity—but it also tends to the advancement of knowledge, by enabling the printer to multiply the copies of the same book. This, however, leads us from the art of paper-making to that of printing; a short account of which cannot fail to interest.

Letter-press printing has been for so many years practised amongst us, that it has almost ceased to excite either admiration or curiosity. The principles of the operation are so obvious, and the execution so easy, that in regarding the whole process of making a book, from the formation of the paper, the types and the ink, the binding, until it comes into our

hands fit for perusal, we almost suppose it an invention which the most common abilities might attain. This careless manner of considering the art, certainly argues a want of gratitude for the many benefits we receive from it; and yet, to no one branch of art are we so much indebted as to printing. To the discovery and improvements in letter-press printing, may justly be ascribed, that rapid advancement in agriculture and manufactures, in arts and sciences, which has taken place within the last three hundred years. The history of the art, however, is most interesting; and, as every one who is able to read, must feel the importance of the discovery, we shall endeavour to gratify his laudable curiosity, by stating, very briefly, the circumstances which led to it.

Before the year 1440, all books were written with a pen; and, as it must often employ a copyist for years to transcribe a single book, few persons, we may well believe, could afford to buy one, and therefore, the number of readers must have been very small. Suppose a spelling-book were to be written out by hand-labour, it would require a long period to

furnish a single copy, so that the poor were altogether deprived of the benefits of education; to-day the printer would set up his types and strike off many impressions of a book, whilst the copyist would be transcribing a single one.

It was about this period, that Laurence, Koster, a respectable inhabitant of Harlaem, in Holland, walking in a wood, near the city, began at first to cut some letters upon the bark of a beech-tree, which being impressed upon paper, he printed one or two lines, with the view of teaching his grand children to read. The plan of printing a few lines having happily succeeded, he meditated great things, as he was a man of ingenuity and judgment; and first of all, invented a better kind of ink, because he found that the common ink sunk and spread, and then formed whole pages of wood with letters cut on them; in these it is remarkable that he printed only on one side of the paper, the backs of each couple of pages being pasted together. These beechen letters being easily spoiled by use, he afterwards changed for leaden ones; but finding this metal too soft to bear the press, he changed these again for a mixture of tin

and lead, which has now been changed into one of antimony and lead, of which all printing types are at present made.

This discovery was for some time kept a profound secret; and, it is even said, that all the first printed books were sold as manuscripts, till the number of books, and their exact conformity to each other, even in their faults, (which could never occur if they had been written by different persons,) led to a discovery of the means employed. Since that period, the art of printing has been advancing towards perfection, and knowledge has also been increasing. The works of the wise and learned are not now liable to be lost, as must have frequently happened, when every book was written with the pen, or known to but a few; since from the multiplication of books, even the poorest person may ensure to himself an instructive and entertaining occupation for his leisure hours, by learning to read them.

Perhaps a more striking instance cannot be brought, of the improvements of modern times, both in knowledge and the arts, than that which the history of printing affords. The whole apparatus of Laurence's printing press, prob-

ably did not cost him five pounds, when he first began ; whilst, there are printing presses at present worked by steam engines in London, the erecting of which cost twenty thousand pounds. In the sixteenth century, the Queen of Scotland did not possess one hundred books in her library, though she was very fond of reading ; to-day, there are few men, a little raised above the humblest class in life, who have not almost as many.

The person who makes these letters for the printer, is the type-founder, whose business it is to prepare the metal, which is a composition of lead and another called antimony, melted together in a furnace. In large founderies, this mixed metal is cast into bars of twenty pounds each, which are delivered to the workmen as occasion may require ; this is a laborious and unwholesome part of the business, owing to the flames which are thrown off. In large type-founderies, about fifteen hundred weight of this metal is cast in a day, and the founders usually cast as much at one casting as will last six months.

We now come to the letter-cutter : that is, to him who cuts the moulds in which

the letters are cast; he must be provided with vices, hammers, files, gravers, and gauges of various kinds. He then prepares steel punches, on the face of which he draws or marks the exact shape of the letter; and, with pointed gravers and sculpters he digs out the steel between the strokes or marks which he made on the face of the punch, leaving the marks standing. Having shaped the inside strokes of the letter, he deepens the hollows with the same tools: for if a letter be not deep in proportion to its width, it will when used at press print black, and be good for nothing. He then works the outside with files, till it is fit for the matrice.

A matrice is a piece of brass or copper, about an inch and half long, and thick in proportion to the size of the letter it is to contain. In this metal is sunk the face of the letter intended to be cast, by striking the letter-punch. After this, the sides and face of the matrice must be cleared, with files, of all bunchings made by sinking the punch.

When the metal is melted, and other things are properly prepared, the matrice is fastened to the end of the mould, which

the caster holds in his left hand, while he pours the metal in with his right; by a sudden jerk of the hand, the metal runs into the cavity of the matrice, and takes the figure or impression. The mould consists of an under and an upper half, of which the latter is taken off, as soon as the letter is cast; he then throws the letter upon a sheet of paper, laid for the purpose on a bench or table, and he is ready to cast another letter as before.

When the casters have made a certain number of types, which are made much longer than they are wanted, boys come and break away the jets or extra lengths from the types; the jets they cast into the pot to be re-melted, and the types are carried to another workman, who polishes their broadsides. This is a very dexterous operation; for the man, in turning up the types, does it so quickly, by a mere touch of the fingers of the left hand, as not to require the least perceptible intermission in the motion of the right hand upon the stone.

A type-founder will cast upwards of three thousand letters in one day; and the perfection of letters thus cast, consists

in their being all straight and square, of the same height, and evenly lined, without sloping one way or the other.

What is called a fount or font of letter, is a quantity of each kind cast by the letter-founder, and properly sorted. A complete fount includes, besides the running letters, all the single letters, double letters, accented letters, points, lines, numerical characters, &c.

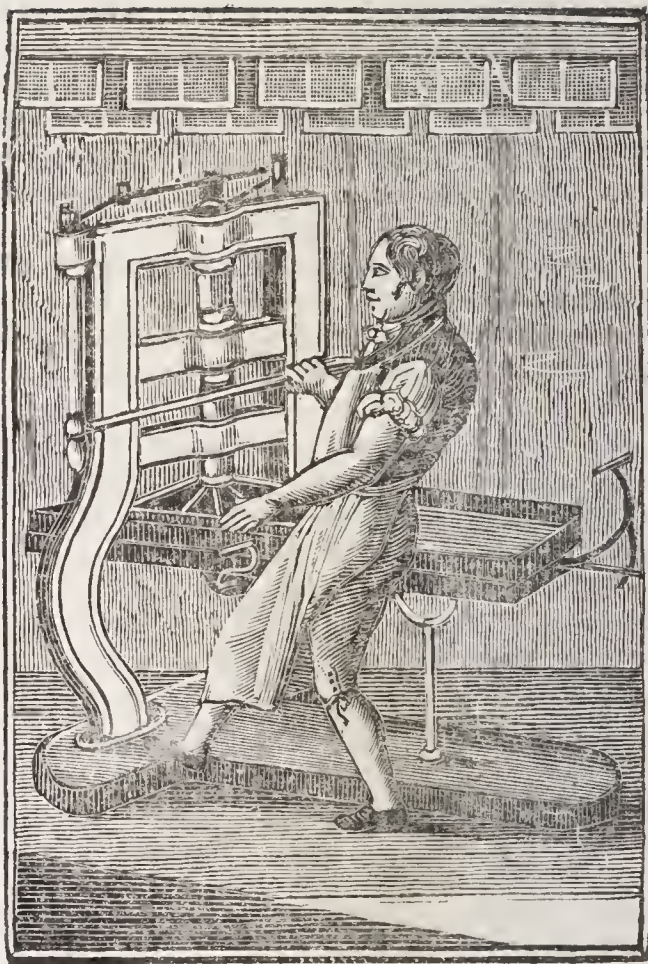
Letter-founders have a kind of list by which they regulate their founts: this is absolutely necessary, as some letters are much more frequently used than others, of course the cells containing these should be better stored than those of the letters which do not so often recur. Thus a fount does not contain an equal number of a and b, or of e and x. In a fount containing a hundred thousand characters, the a should have five thousand, the c three thousand, the e eleven thousand, the i six thousand, and the other letters in proportion.

Printers order their founts either by the hundred weight or by the sheet. If they order a fount of five hundred, they mean that the whole shall weigh about five hundred pounds; but if they require a

fount of ten sheets, it is understood, that with this fount they shall be able to compose ten sheets, or twenty forms, without being obliged to distribute. The founder reckons one hundred and twenty pounds to a sheet; but this varies with the nature of the letter.

Having now described the mode of forming the letters, we shall give an account of the use that is made of them by the letter-press printer.





LETTER-PRESS PRINTER.

THE ART OF PRINTING.

THE workmen employed in this art, are compositors and pressmen. The first are those persons whose business it is to range and dispose the letters into words, lines, pages, &c.

The pressmen are those who take off the impression from the letters, after they are prepared for that purpose by the compositors.

The types being provided for the compositor, he distributes each kind, or sort, by itself, into small boxes, made in two wooden frames, called the cases; the upper-case and the lower-case.

The upper-case contains two alphabets of capitals; large, or full capitals, and small capitals. It also contains boxes for the figures, the accented letters, the characters used in references to notes, &c. &c. making in all, ninety-eight.

The lower-case is appropriated to the small letters, the double letters, the points, parentheses, spaces, and quadrats. The boxes of the lower-case, are of different sizes; the largest being for

the letters most in use; they are fifty-three in number.

The instrument in which the letters are set, is called a composing-stick, which consists of a plate of iron, on the side of which arises a ledge, which runs the whole length of the plate, and serves to support the letters. Along this ledge is a row of holes, for introducing a screw to lengthen or shorten the line, by moving the sliders farther from, or nearer to the shorter ledge at the end of the composing-stick.

Before the compositor begins to compose, he puts a thin slip of brass, cut to the length of the line, in the composing-stick; he holds the stick in his left hand, and takes up the letters with his right, while he supports them with his left thumb, by pressing them against the slider.—Having in this manner composed a line, he takes the brass rule from behind it, and places it before the letters of which it is composed, and proceeds to compose another line in the same manner. Nothing appears more extraordinary, than the quickness with which the compositor works. If a person unacquainted with this business, were to com-

pose a few lines, it is not too much to say, that it would employ two hours to find in what box each of the letters was distributed, (for they are not ranged regularly, but as before mentioned, according to their being more or less in use,) and afterwards to pick them out and lay them in proper order, on the composing-stick. A good workman on the contrary, acquires by practice, such dexterity, that the eye can scarcely follow his hand in its rapid motion from the stick, when he lays down each letter, to the exact compartment, in which the following one is to be found.

When the composing-stick has been filled with lines, the compositor, keeping the letters carefully in their proper places, empties it on a thin board, called a galley, being of an oblong shape, with a ledge on two sides. When he has finished a page, he ties it up with a piece of pack-thread, and removes it to some safe place until he has composed as many pages as are required to make a sheet. He then arranges the pages on the imposing-stone, which is a large oblong stone, of three or four inches in thickness. Having disposed the pages, so

that when they are printed, they may be folded to follow each other regularly, the compositor proceeds to what is called dressing the chases. The chase is a rectangular iron frame, with two cross pieces, of the same metal, called a long and short cross, mortised at each end, so as to be taken out occasionally.

To dress the chase, a set of furniture is necessary; consisting of small slips of wood of different dimensions. The first thing to be done, is to lay the chase over the pages: after this, that part of the furniture called gutter-sticks, are placed between the respective pages.

Then another part of the furniture called reglets, are placed along the crosses of the chase, of such thickness as will let the book have proper margins after it is bound. The compositor then secures the outsides of the pages, by putting side-sticks and foot-sticks to them, and fastens them together by wooden wedges, called quoins.

The work in this condition is called a form, and is ready for the pressman, who lays it upon the press for the purpose of pulling a proof. When a proof is pulled, the form or forms are rubbed over with a

brush, dipped in lye, made of pearl-ash and water.

After a proof sheet has been read, and the errors marked on the margin, it is again put into the hands of the compositor, who proceeds to correct in the metal what has been marked for correction in the proof.

When the sheet is supposed to be correct, the forms are given to the pressman, whose business it is to work them off; in doing which, four things are required: paper, ink, balls, and a press. The paper is prepared for use by being dipped in water, and afterwards laid in a heap, on which are placed heavy weights.

Printing-ink is a preparation of drying-oil, ivory-black, lamp-black, &c. finely ground together. The balls used in laying the ink on the form, are a kind of wooden funnels, with handles, the cavities of which are stuffed with wool, and covered over with a sheep skin prepared for the purpose; or with a piece of coarse cloth, on which is spread a composition of glue and treacle. There is also another mode of laying on the ink, by means of rollers, not unlike what we see used to keep the walks of gardens smooth, but

much smaller ; they are made of the same composition as the balls.

The press is a curious and complex machine ; to give a description of which would exceed the limits of this short sketch. When the form is made ready on the press, and every thing is prepared for working, one man beats the letters with the inked balls, or runs the roller over them, thus covering the types with ink ; another lays on them a sheet of paper, and brings off the impression by pulling a lever or bar, which squeezes the paper against the types, and causes it to take off the ink from them, thus marking it with the letters. Having printed on one side, all the sheets of which the edition is to consist, provided the number be not large, the form for the other side of the sheet is laid on the press, and worked off in the same manner. If, however, the edition should consist of a very large number of copies, the paper after being printed on one side, would dry before the pressman could give the impression to the other ; to avoid this inconvenience, therefore, two presses are used, for the purpose of striking off both sides of the sheet successively. If requisite,

the whole is then powerfully pressed, to give a smoothness and finish to the surface; when the book is considered complete, and ready for folding, stitching, and binding.

A great improvement has lately been made in the construction of printing presses, which promises many important advantages. A common press, worked by two men, takes off but 250 impressions on one side in one hour, and requires eight hours to work off 1000 sheets. In the newly invented engine, which is wrought by the power of steam, three boys can, in the same time, perfect 24000 sheets; which, it is evident, must have the effect of lowering the expense of printing, and consequently the price of books.

In its general form, this press resembles the rolling press of copper-plate printers. The forms being fixed on the carriage, are pushed under a roller, on which the sheet is disposed; and the ink being laid on by an ingenious contrivance, the impression is taken on one side. The sheet is then conveyed by machinery to a second roller, around which it is carried on the second form, when it receives the

impression on the remaining blank side. All the manual labour, as before mentioned, is performed by one boy, who lays the sheet of paper on the first roller—a second, who takes it off from the second cylinder—and by a third, who lays the sheets even, after the printing of each has been completed. It may also be mentioned, as a further instance of ingenious management, that the waste steam from the copper, is carried in tubes round the entire range of workshops, in order to warm them.

Stereotype printing was first adopted in these countries by the University of Edinburgh, and has since been extended with much success, by several artists in England. The mode of stereotype printing is first to set up a page of the intended book, in the common way, with the common types, and when it is rendered perfectly correct, a cast or mould is taken from it, and in this cast, the metal for the stereotype plate is poured; hence the name, which signifies fixed or immoveable types. For standard and extensively circulating works, such as the Holy Scriptures, and the works of the best authors, who being dead, their books

can receive no more alteration in style, language, or matter, the invention is invaluable, as the chief expense of future editions (the composition) is avoided; the original types may be devoted to their former use; and the plates being always ready, the bookseller strikes off such a number of copies, and thus requires so much paper only, as will answer the demand.



The ART of BINDING BOOKS.

LET us now follow the printed paper, after it has left the printing press, to the workshop of the artizan who gives it the form of the book you are now reading. The bookbinder first folds the sheets with a folding-stick, and lays them over each other in the order of the signatures, which are the letters with the numbers annexed to them, at the bottom of some of the pages in each sheet. The leaves thus folded, are then beaten on a smooth stone with a heavy hammer, (to make them smooth and open well,) and afterwards pressed. They are next sewed upon bands, or pieces of cord or packthread, which is done by drawing a thread through the middle of each sheet, and giving it a turn round each band. After this, the books are glued, and the bands opened and scraped, for the better fixing the paste-boards, which are to form the cover; these being applied, holes are made for fixing them to the book, which is again pressed. Then the book is at

last put to the cutting-press, betwixt two boards, the one lying even with the press, for the knife to run upon, the other above it, for the knife to run against; after which the pasteboards are squared.

The next operation is sprinkling the edges of the leaves, which is done by dipping a brush into the intended colour, holding the brush with one hand, and spreading the hair with the other, by which motion the edges of the leaves are sprinkled in a regular manner, without any spots being longer than the rest.

The outside covering, which is generally either of calf or sheep skin, or sometimes of linen or calico, is then fixed with paste to the pasteboards, and doubled over the edges withinside, after having first taken off and indented and platted the cover at the head-band; which done, the book is bound firmly with bands, in order to keep the work close, and then set to dry. It is afterwards washed over with paste and water, and then finely sprinkled with a brush, unless it should be marbled, when the colouring matter is thrown on more freely;—black and brown are the most common colours for

book backs ; the first is obtained from a solution of copperas, the last from pearl ash. After this, the book is rubbed over with the white of eggs ; and at last polished with a polishing iron, passed hot over the cover.

The letters or other ornaments on books, are made with gilding tools, engraved in raised letters, which are fixed either on the points of puncheons or round little cylinders of brass. The puncheons make their impressions by being pressed flat down, and the cylinders by being rolled along by a handle, to which they are fitted like a wheel. To apply the gold, the binders rub the parts with the white of egg, or serum of blood, by means of a sponge, and when nearly dry, the pieces of gold leaf are laid on ; the tools being made hot in a charcoal fire, are also laid on, and the book is pressed off, sometimes between pieces of horn, and finished.

Consider now, the numerous hands through which even the little book in which you learned your letters must pass, before it was fitted for your perusal — there was the grower of the flax, the

hackler, carder, and spinner, the weaver, and after the linen has been worn, the ragman, the picker, the sorter, the different workmen who make it into paper, the author who wrote for your instruction, the type-founder, the letter-press-printer, the bookbinder ;—reflect, also, upon the labour necessary in preparing the metal, the ink, the printing press, the leather—all these persons living in different places, perhaps having never seen each other, yet all conducing through the means of merchants, ships, master mechanics, and booksellers, to improve your mind, and make you capable of attaining that knowledge, which the wise King Solomon has said is better than riches.

Shall any one then neglect the instruction which it is so much his own interest and advantage to receive, and which so many have laboured to give? Shall any young person neglect his book, or trifle away his precious hours in idle play, when so many men have expended their time, their talents, their industry, to produce a book which is to make him wiser, and happier, and better? Each good boy will surely hope that the num-

ber of such is small ; and he will, also, endeavour with all his might, not to be ranked amongst those, who turn a deaf ear to wisdom, and will not listen to her advice.



MANUFACTURE OF SUGAR.

THIS article, which is applied to so many useful purposes, is made from the juice of the sugar-cane, a kind of reed, in the soft pith of which, the sugary matter is contained. It is a lucrative branch of revenue; and both in its cultivation and produce, gives employment to thousands of our fellow-creatures.

Before we enter, however, upon the description of this manufacture, it may be necessary to describe the appearances of the plant from which it is obtained.—It is cultivated in the West India islands, and rises to the height of about seven feet, in a straight reed, which is separated into joints, about three inches long, and one inch in diameter. It is topped by a bunch of leaves or blades, sharply notched at the edges like a saw, and bears a beautiful flower of a bright golden colour, streaked with red; from the centre of the leaves, shoots up an arrow, like a silver wand, from two to six feet in length, producing from its summit a plume of delicate white feathers, which are mixed with yellow. K

When cut down, the leaves are thrown aside, as of no use in the manufacture of sugar, and the stems or canes are divided into pieces, each about a yard in length. These are tied together in bundles, and conveyed to the sugar mill, where they are bruised betwixt three upright wooden rollers, covered with iron. The juice which flows from them during this process, is conducted by canals into a large vessel formed for receiving it. The quantity of juice prepared by some mills in the West Indies, is upwards of 10,000 gallons in a day.

The next operation, is that of freeing it from all impurities, which is called clarifying. For this purpose, the juice is conducted along a wooden gutter lined with lead, to a place called the boiling-house, where it is received into copper pans or cauldrons, each placed over a separate fire. A certain proportion of powdered lime is now added to it, this being found to remove any acid which the juice may happen to contain. When the liquor boils, the greater part of the impurities contained in the juice, rise to the surface in a scum. The purified liquor is then carefully drawn off by a

cock, leaving the scum at the bottom of the pan.

From these pans it is conveyed, by another gutter or channel, to the grand copper, or evaporating boiler, where the scum which rises to the surface, is skimmed off as the liquor boils. After undergoing a similar process in smaller boilers, until it has acquired a certain degree of thickness, it is transferred into a large shallow wooden vessel, where as it cools, it granulates, or runs into an imperfect crystallization, by which it is in some degree separated from the molasses or treacle, an impure part of the juice, which is incapable of crystallization, and which is exported in large casks, for various useful purposes, to the different countries of Europe.

From the wooden vessels the sugar is removed to the curing house. This is a spacious airy building, furnished with a large cistern for the reception of the molasses; over the cistern is an open frame of strong joist work, upon which are placed several empty hogsheads, each open at the head, and having a few holes at the bottom, closed by stalks of the plantain-tree thrust through them. The mass

of sugary matter is now put into these hogsheads; the molasses drain into the cistern through the spongy stalk of the plaintain, and the remainder, thus regularly crystallized, has the name of *muscovado* or *raw sugar*.

That which is called *clayed sugar*, undergoes a process somewhat different. For the preparation of this, the sugar when taken from the coolers, is put into conical vessels of earthen ware, each having at its smaller end, a hole about half an inch in diameter, which at the beginning of the process is stopped with a plug. This plug, after the sugar has become perfectly cool, is removed, and the molasses drain through the hole; when these have ceased to run, the surface of the sugar in the vessel is covered with fine clay to a certain thickness, and water is poured upon the clay. This oozing through the whole mass of sugar in the mould, dissolves the molasses still remaining in it, and carrying it off through the hole in the bottom, renders the sugar that is left, much purer than that which is prepared the other way.

The further refining of sugar, or forming it into the white conical loaves which

are so much used in this country, is the business of the European sugar bakers. This is done by dissolving the raw sugar in water, boiling the solution in lime-water, and then clarifying it with bullocks' blood or the white of eggs, and straining it through woollen bags. After due evaporation, it is suffered to cool to a certain degree: it is then poured into conical moulds of unglazed earthen ware, the narrow ends of which are left open. Here it hardens into a white mass, leaving that part of the sugar which will not crystallize, to run off through the hole in the point of the cone. The broad end of the cone is then covered with moist clay, the water from which filters through the sugar, carrying off the impurities which otherwise would remain in and discolour it. It is then carefully dried, and receives the name of *loaf* or *lump sugar*.

The juice of the sugar cane is so palatable, and at the same time so nutritive, that during the sugar harvest, every creature which partakes freely of it, whether man or beast, appears to derive health and vigour from its use. The meagre and sickly Negroes, exhibit at this season a surprising alteration, and now become

fat and healthy. The labouring horses, oxen and mules, being allowed almost without restraint to eat of the refuse plants and of the scummings from the boiling house, improve now infinitely more than they do at any other season of the year.

When sugar was first introduced into this country, it was employed only as a medicine ; but it has now become an essential article both of luxury and use. To enumerate the different purposes to which it is applied would be endless ; it will suffice, however, to mention, that it is the chief ingredient in syrups, and in various kinds of cookery.

We have now described the mode, by which the sugar, so much in use, is produced ; but there are various other plants, besides the sugar cane, which yield even a superior quantity of sugary juice ; and, therefore, a short account of the process by which it is obtained from them, will not be uninteresting.

The first of these is the sugar maple-tree, which is found in great plenty in North America, a district of many miles in extent being in some places quite covered with them. The process of obtaining the juice is, in the spring of the

year to bore holes about two inches deep into the tree, and to put into each of these a spout, by which it may be conveyed into troughs fitted to receive it. Each tree will afford from *twenty* to *thirty* gallons of juice, from which may be obtained *five* or *six* pounds of sugar; and it is a remarkable fact, that the tree, so far from being injured by tapping it, is improved; so that a single tree has not only survived, but flourished after *forty-two* tapplings, in the same number of years. The oftener it is tapped, the more sugar is obtained from it; and this is proved from the superior excellence of those trees, which have been pierced in many places by the bird called the wood-pecker, which feeds on its juice.

The juice is clear, of pleasant flavour, and in its simple state is sometimes drunk as a remedy against the scurvy.

The principal method of making sugar from the sap, is by boiling; and the Americans have found from experience, that the sap should never be kept longer than twenty-four hours, after it is collected, before it is put on the fire. During the boiling, they add butter, hog's lard, and tallow, to prevent the pan or kettle from

boiling over ; and fresh eggs or new milk are mixed with the juice, in order to clarify it. The quantity, however, of these ingredients, is not great, since a spoonful of slacked lime, the white of one egg, or a pint of new milk, will be sufficient to clarify fifteen gallons of sap. The sugar after being boiled, is conducted through the remaining process, nearly in the same manner as in the West Indies, from the sugar cane ; it will, therefore, be unnecessary to repeat what has been already said.

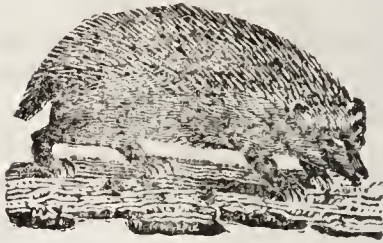
When we consider that the sugar maple's juice is collected at a season, when not a single insect exists to feed upon it, and before any of the dust of plants can float in the air and mix with it—that many millions of acres in North America are covered with it, and that the process of collecting the juice and preparing it is so simple, that any one may carry it on without expense—We are led to acknowledge, that it is the gift of a kind and bountiful Providence, which in all countries invites the industry of mankind, and repays him by every thing which can conduce to his support and comfort.

The last substance which we shall men-

tion, as affording sweet sap in sufficient quantity to make the manufacture of it profitable, is the beet-root; which was cultivated in such large quantities in France, during the late war, as to render that country altogether independent of a supply of sugar from the West India colonies. Like the sugar cane, the root of the beet is submitted to the pressure of huge rollers, which, however, are of cast iron; and the juice thus expressed being boiled and clarified with lime, &c. gradually cools into crystals, like our brown sugar; or is, by the filtration of water through conical moulds, freed from all impurities, and made equal in fineness and whiteness to our hardest loaf-sugar.

Let us now, in conclusion, reflect how many thousands of our fellow-creatures are supported by the manufacture of sugar. How many are employed in the cultivation of the plant; how many more in passing it through the various processes it undergoes; how many industrious tradesmen have been engaged in building the necessary machines, the sugar-houses, the coolers, the boiling pans, the vessel which is to convey it to our shores :—and

is it too much to say, that the sugar which goes to sweeten a cup of tea, has passed through the hands of, and contributed to give food and employment to above *one thousand* industrious persons?



The MANUFACTURE of SALT.

THERE are few productions so much in request, or indeed so useful, as common salt. It is used as a seasoning of food by the inhabitants of all countries; and by the poor as well as by the rich. The peasant would lose half the relish for his frugal meal, if he had not salt to eat with his potatoes; and the experienced cook knows how essential its presence is in the most luxurious dishes. It also has the effect of preserving different articles of food from putridity; thus enabling the seaman to lay in stores of flesh meat for the longest voyage. It is used, likewise, in medicine, and for glazing the surface of earthen ware; and, lastly, is employed in several chymical processes. Considerable quantities, therefore, it may be supposed, of this necessary article, are requisite; and it is another proof of the goodness with which Providence supplies all our wants, that it exists in various states, and in the greatest abundance.

When this substance is dug out of the earth, it is called rock salt; and immense

masses of it are found in different countries of the world. The most considerable, as well as the most celebrated salt mines with which we are acquainted, are about five miles from Cracow, in Poland ; and it is supposed that they contain as much salt, as would be sufficient to supply the wants of the whole world for several thousand years.

On descending to the bottom of these mines, a stranger is astonished at the sight that presents itself to his view.—He sees, as it were, a spacious plain, nearly a quarter of a mile under ground, containing a kind of city, with houses, chapels, carriages, roads, &c. scooped out of one vast rock of salt, as bright in some places as crystal ; while the torches which are kept constantly burning, to give light to the workmen, being reflected from the glassy surface of the salt, afford a sparkling lustre, more splendid than any thing above ground could possibly exhibit. Through the midst of the plain, lies a road, which is always filled with carriages, conveying large blocks of salt from the farther part of the mine to the mouth or entrance, (which is like a well, up which they are drawn in bas-

kets by ropes and pulleys,) and returning empty after having laid down their loads. A great many horses are necessarily employed there, and when once let down never see the day-light again. The miners, however, do not remain constantly below, as was for a long time believed; but having wrought for a certain number of hours, are relieved by another set, and thus enjoy the opportunity of breathing the fresh air, and enjoying the cheerful light of day. In several parts of the mine, small chapels are scooped out in the salt rock, and in them mass is said on certain days. One of those is thirty feet long, and twenty-five feet broad; the altar, crucifix, ornaments of the church, and statues of several saints, being all carved out of the salt. In the year 1780, the greatest depth to which the workmen had penetrated, was about 320 yards; and the mass or bed of salt, was considered to be in some places more than 240 yards in thickness, and to extend, at least, nine miles under ground.

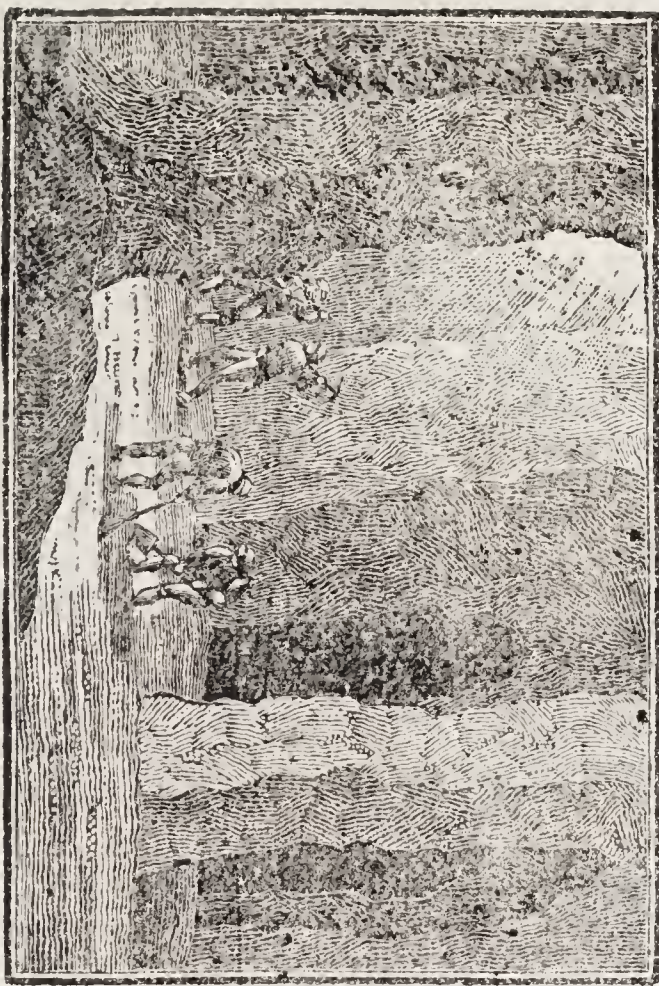
Near the town of Cardona, in Spain, there is a mountain of salt without a cleft, 500 feet high, and nearly three miles in circumference. In the province

of Lahor, in India, travellers have also described a mountain of salt, not inferior in magnitude.

At Northwich and Nantwich, in Cheshire, in England, there are salt mines of great depth and extent. These are frequently visited by travellers, and are found amply to repay the trouble and inconvenience of descending into them. They are worked in streets or aisles, large masses from the body of the rock being separated by blasting with gunpowder, and pillars of salt six or eight yards square, being left standing at different intervals, to support the roof.

Rock salt, however, being found more or less mixed with earthy particles, it is necessary to pound the masses when raised to the surface. It is then placed in large cisterns, which are filled with water, —salt water is always preferred for this purpose; and, on this account, manufactories of salt are generally situated on the sea shore. The water having become saturated with salt, is drawn off pure, leaving the earthy particles at the bottom of the cistern; and is conveyed into a large shallow pan, where it is boiled until the water has evaporated in steam, leaving

A SALT MINE.



the crystals of salt behind. If the heat be strong, the salt is fine, like that used for the table; if, on the contrary, the boiling is carried on slowly, the grains are then larger, like what is employed for kitchen use.

Thus we see Nature provides salt for our various purposes in abundance, and the process by which it is prepared for consumption, is at once simple and easily carried on. Salt mines, however, and mountains of salt, it has been remarked, are generally found in the inland parts of a country. On the sea coast, this useful substance is procured in the greatest profusion, the water of the ocean being, as every one knows, an inexhaustible source from which we can extract as much as we desire.

The following is the mode of obtaining salt from sea water, in the British islands. Close to the sea side, a bason or pond is formed, into which, however, the tide or the waves are not allowed to flow. Into this pond, the sea water is received by a sluice gate; and standing there for some time, exposed to the air, the watery parts evaporate, and the remainder is found much salter than before. This brine

is next pumped into the boiling pan, under which a fire is so placed, that the flame and heat from it may spread all over the bottom of the pan. When the liquor is beginning to grow warm, the workman beats the whites of a few eggs in an equal number of gallons of water, which he pours into the pan, and mixes with a rake. This is to clarify the water, and when it boils, a black frothy scum collects and is taken off, leaving the water perfectly clear and transparent; which is then briskly boiled, till much of the watery part is driven off in steam, and the remainder becomes a very strong brine. Small crystals of salt begin now to form on the surface, and this, in a pan fifteen feet long and twelve broad, generally happens in five hours boiling. The pan is again filled with water, and a second clarification, evaporation, and crystallization take place. This is repeated a third time; and when the crystals are forming, the fire is slackened, so as to leave the brine simmering. The salt is now drawn up in heaps at the sides of the pan, where it drains for some time; it is then taken out and placed on proper frames, till all the moisture is entirely

drawn off, and the salt is fit to be removed to the stores, where it is sold for use.

But fuel being scarce and dear, in Holland and other parts of the continent, where salt is made from sea water, a contrivance has been found out to reduce the expence of it, and this has succeeded so well, by the graduated buildings, that seven thousand casks of salt, each weighing 650 pounds, are now obtained with the sixth-part of the quantity of wood which before was necessary. The graduated building consists of several stories, each of which resembles a room, in which the rafters have been just laid, and are not yet covered with flooring; these stories are more or less numerous, according to the greater degree of the water's saltiness. Every division or space, between the rafters, is filled up to the top with large bundles of twigs. The water drawn from the salt wells, and carried into a tub, at the bottom of the room, is raised by pumps to the top of the first division, where it is distributed into troughs of about four or five inches in width, and as much in depth. These are disposed according to the length of the building, are pierced at every six inches,

and have little cocks, which allow this water to fall drop by drop upon the bundle of twigs. The water tumbled about, and separated through all the minute branches of the twigs, is thus exposed to the air, which causes a great portion to pass away in vapour, leaving the salty particles behind. A favourable wind is a great assistance to the work, and carries away great part of these divided waters, by making it pass obliquely through the twigs. The particles of water which remain still united to the salt, have, according to their weight, many little falls, perpendicularly, from sprig to sprig, till they come to the bason at the bottom intended to receive them. They are then raised by other pumps to the troughs and twigs of the second division, where they acquire a greater degree of saltiness, by a new dissipation of the fresh water: and so on, according as it is found necessary, to a sixth or seventh division. Thus, almost without expense, and in three days, at a proper season of the year, a pound of salt water, which, when it first came from the well, contained a certain small quantity of salt; suppose, for instance, the weight of one dram, may acquire

twenty, twenty-five, or even thirty times as much, when it comes to the bason of the seventh division; and gives, at the crystallization, which is performed at last by fire, the weight of four ounces of salt.

A fourth way in which salt may be procured, is from the water of salt springs, or from salt water lakes, which are found of great extent in the interior parts of Asia. In warm climates, the water is drawn into shallow basons, where the heat of the sun evaporates the moisture, and the salt crystallizes without any preparation. This, however, is very impure, and requires to be again dissolved, clarified, and crystallized.

In addition to the other uses of salt, it may be mentioned, that physicians have discovered that it furnishes an efficacious mode of purifying the air of a house or room, where there are persons suffering under contagious fevers, and thus preventing the spreading of infectious disorders. Every one knows, that in these cases, the air which has been breathed by the patient becomes so impure, that it is dangerous for persons in health to inhale it and it is, therefore, of the greatest im-

portance to clear it of these noxious particles which render it putrid. The careful nurse can then enter the sick chamber without fear of catching the disorder; and the kind and anxious relative continue her affectionate care and attention to the patient, without, as it oftentimes has happened, endangering her life. It was the discovery of a learned chemist, of Dijon, in France, who, in 1773, finding that the cathedral of that city was entirely deserted, on account of the infectious smell produced by the corruption of bodies buried within its walls, placed a mixture of common salt and oil of vitriol, in a pan over burning coals, in the middle of the church, and then withdrew, taking care to close all the doors and windows, to confine the fumes from escaping.—These accordingly filled the whole cathedral; and in twelve hours, when the doors were thrown open, were found to have destroyed every putrid odour.

As it is desirable that every person should know this simple but effectual mode of checking a contagious disorder, and purifying the air of a sick house, we shall subjoin the directions which are given for its use:—Take six drachms of

common salt and the same quantity of oil of vitriol, which is sold by the druggist or apothecary, and mix them gradually in a tea cup. During the preparation, the cup must be placed on a fire shovel, or any other piece of heated iron, and the mixture stirred with a tobacco pipe or a piece of glass. As soon as the fumes arise, the cup is to be moved about to different parts of the room or house, that are to be fumigated.

It is necessary, however, to add, that the fumes of common salt and vitriol are not sufficient of themselves to prevent infection. They clear the air of those putrid odours which would communicate the disorder, but it is equally essential to attend to other directions, which were drawn up by some humane and skilful physicians, when the typhus fever raged with such violence through this country, in the years 1817 and 1818. At that distressing period, the hospitals were thrown open for the reception of the sick, and several houses also fitted up by government, where they had the kindest and most careful treatment. The rules, therefore, which follow, suppose the patient to have been removed to one of these asy-

lums; but it is evident, that most of them are equally useful in cases when the patient remains at home. It would be well for every one of our young readers to commit them to memory, as he may thus, perhaps, on some future occasion, under the blessing of Divine Providence, be the means of saving his own life, or that of some dear friend or relation.

1. Let all your doors and windows, except those of the sick room, be thrown open, and let them remain so throughout the day.

2. Let the house, room, or cabin, be well cleaned; the floors, wood work, and furniture, be well scrubbed; all dirty clothes be first steeped in cold water, and afterwards washed in warm water and soap.

3. Let the clothes you wear be steeped in cold water, and afterwards washed; and let any chest, box, drawers, &c. in the infectious house, be emptied and cleansed.

4. If you lie on straw beds, let the straw be immediately burnt, and fresh straw provided; and let the ticken be steeped in cold water.

5. Whitewash all your rooms, and the entrance to them, with lime slacked in the place where it is intended to be used, and while it continues bubbling and hot.

And, lastly, wash your hands, face, and feet, and comb your hair well, every morning and evening, at least.

The benefit of this advice, (continue these benevolent persons,) you will soon feel, after infection has entered your dwelling; and persevering in your attention to it, will, under God's protection, preserve you from all the variety of wretchedness occasioned by contagious fevers.

Attend to it then with spirit and punctuality, for be assured that cleanliness will check disease, improve your health and strength and encrease your comfort.

Perhaps, then, it is not too much to say, that to this cheap and most useful commodity, we may at some future time be indebted under God, for protection against a pestilence. Almost every one has heard of that great plague, which raged in London about one hundred and fifty years ago, and cut off nearly ninety thousand of its inhabitants. The streets were deserted, the houses either left empty

by their owners, who fled to the country or else shut up by the magistrates, who were obliged to adopt this mode of checking the progress of infection.—Had they known this little mixture of common salt and oil of vitriol, doubtless the contagion would not have spread so widely, nor would it have been so fatal to those whose duty it was to attend the sick.

The inhabitants of Cardona make of the rock salt in their neighbourhood, various transparent articles, which they sell at a cheap rate. These, which consist of small altars, figures of saints, crosses, chandeliers, salt cellars, &c. are as clear as crystal, and to appearance as lasting.



BREWING.

NEXT to wheat, which when made into bread has emphatically been called the *staff of life*, barley is considered the most valuable kind of grain. The principal use to which it is applied in this country, is in the making of malt, from which beer, porter, ale and spirits are prepared. For this purpose, it is first steeped in water for three or four days;—it is then taken out, and suffered to lie till it begins to sprout; as soon as this has advanced to a certain state, its farther progress is prevented by drying it in a kiln, heated with coke or charcoal. The grain has now become mellow and sweet; and after being crushed in a kind of mill, becomes fit for the brewer, in whose hands, the process of making beer is completed.

Malt liquor, in general, is composed of water, malt, hops, and a little yeast; and the great art is to find out the proper proportions of each ingredient, and how to work them together afterwards.

The first part of the operation, when the malt has been mixed with hot water, is called mashing; which is performed in

a large circular vessel, called a mash-tub, where the liquor is stirred constantly with large rakes, to extract the sweetness of the malt. As soon as the mashing is completed, the tub is covered in to prevent the escape of heat, and after settling, the clear liquor, which is called wort, is allowed to run off into a lower or boiling copper. Before the goodness of the malt is exhausted, it is usual to pour upon it two or three waters.

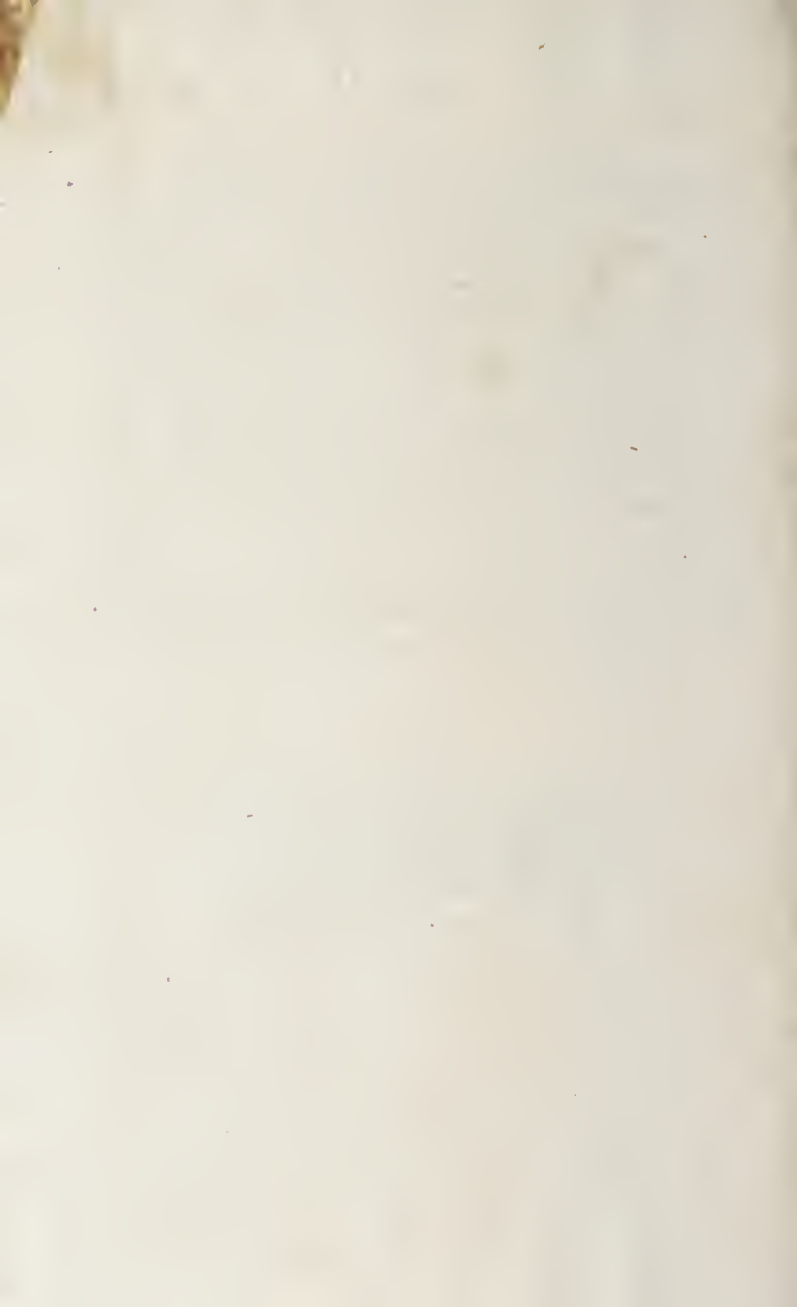
If only one kind of liquor is made, the produce of the three mashings is mixed together; but if ale and table beer are required, the wort of the first, which is by much the richest, or of the first and second mashings, is appropriated to the ale, and the remainder is set aside for the beer. What remains of the malt after the wort has been drained off, is called grains; these are employed for the feeding of horses, cows, and swine.

The wort when run into the lower copper, is to be boiled with a certain quantity of hops, till upon taking out a little of the liquor, it is found to be full of small flakes, something like curdled soap. It is then drawn out into large shallow vessels, called coolers, in which it remains till it is cool enough to be submitted to fermentation.

It is then transferred into the fermenting or working tun, in which it is well mixed with yeast, in order to hasten and assist the process. The last part of the operation is that of transferring the liquor from the working tun to the barrels, where the fermentation is completed. For a few days there will be a copious discharge of yeast from the bung-hole, during which the barrels must from time to time be carefully filled up with fresh liquor. After this discharge is finished, the barrels are bunged up, and the beverage is fit for use in the course of a few weeks.







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